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S-DMSP-3025
08 Mar 1990
PART I OF TWO PARTS

PRIME ITEM DEVELOPMENT SPECIFICATION

FOR THE

MARE IVB TACTICAL WEATHER SATELLITE TERMINALS SYSTEM

CONTRACT NO. F04701-88-C-0124

CDRL SEQUENCE NO. 012A2

08 Mar 1990

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1. SCOPE

1.1 Purpose

This specification establishes the performance, design, development, and test requirements for the fixed site MARK IV-B Tactical Weather Satellite Terminals prime item. The MARK IV-B Tactical Weather Satellite Terminal will be referred to as the system or as the MARK IV-B in this document. The System requirements for the MARK IV-B are defined in SS-DMSP-907. The MARK IV-B is an upgrade of the existing MARK IV Transportable Weather Terminals Systems. The MARK IV system requirements are defined in SS-DMSP-807A.

NOTE: The requirements unique to the mobile MARK IV-B system requirements shall be added to this specification in a later revision.

2. APPLICABLE DOCUMENTS

2.1 Government Documents

The following documents of the exact issue shown form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, precedence shall be in accordance with 3.8.

NOTE: Those documents in the following lists that have a "(T)" following the document number have been tailored by the MARK-IVB Statement of Work (SOW) or other contract documents.

SPECIFICATIONS

Federal Soecifications none

Militarv Soecifications

F-F-310 29 Oct 1957	Filter, Air Conditioning (Viscous-Impingement Type, Replaceable)
DoD-D-1000B(T) 13 May 1983 Amendment 4, 18 Aug 1987	Drawings, Engineering and Associated Lists
MIL-E-4158E 11 Jan 1973 Amendment 3 31 Dec 1985	Electronic Equipment Ground, General Requirements
MIL-E-6051D 7 Sept 1967 Amendment 1, 05 Jul 1968	Electromagnetic Compatibility Requirements for Systems
MIL-P-9024G(T) 06 Jun 1972	Packaging, Handling, and Transportability in System/Equipment Acquisition
MIL-Q-9858A 16 Dec 1963 Amendment 2, 08 Mar 1985	Quality Program Requirements

Other Government Aaencv Specifications

SS-DMSP-807A 15 June 1979 SCN 009 06 June 1980	System Segment Specification (SSS) for the MARK IV Transportable Weather Terminal

SS-DMSP-907(T) 11 July 1988	System Segment Specification (SSS) for the MARK IV-B Fixed Site Tactical Weather Terminals Upgrade
SS-DMSP-907-01 11 July 1988	Addendum 01 to SSS for the Mark IV-B Fixed Site Tactical Weather Terminals Upgrade with Errata sheet #1 dated 25 Aug 1988
Attachment 01 to F04701-88-C-0124 11 Aug 1988	Statement of Work (SOW) for the DMSP Tactical Terminal System Upgrade (MARK IV-B)

STANDARDS

Federal Standards None

Military Standards

DoD-STD-100C 1 Mar 1983 Notice 1, 30 Apr 1980; Notice 2, 28 Nov 1980; Notice 3, 01 Mar 1983; Notice 4, 04 May 1983; Notice 5, 18 Aug 1987; Notice 6, 15 Mar 1988;	Engineering Drawing Practices
MIL-STD-129J 25 Sept 1984 Notice 1, 05 Nov 1986	Marking for Shipment and Storage
MIL-STD-130F 21 May 1982 Notice 1 02 Jul 1984 Notice 2 01 May 1986	Identification Markings of U.S. Military Property
MIL-STD-188-124A 02 Feb 1984	Grounding, Bonding and Shielding
MIL-STD-210C 09 Jan 1987	Climatic Information to Determine Design and Test Requirements for Military Systems and Equipment

MIL-STD-454K(T) Sept 1963; Notice 1, 29 Aug 1986; Notice 2, 26 Feb 1987; Notice 3, 10 Sept 1987; Notice 4, 12 Feb 1988;	Standard General Requirements for Electronic Equipment
MIL-STD-461C(T) 04 Aug 1986 Notice 1, 1 Apr 1987	Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference
MIL-STD-462 31 Jul 1967 Notice 1, 1 Aug 1968 Notice 2, 1 May 1970 Notice 3, 9 Feb 1971 Notice 4, 1 Apr 1980 Notice 5, 4 Aug 1986	Electromagnetic Interference Characteristics, Measurement of
MIL-STD-470A(T) 03 Jan 1983 Notice 1, 28 Apr 1987	Maintainability Program for Systems and Equipment
MIL-STD-721C 12 Jun 81	Definition of Terms for Reliability and Maintainability
MIL-STD-785B(T) 15 Sep 1980 Notice 1, 3 Jul 1986	Reliability Program for Systems and Equipment Development and Production

MIL-STD-810D(T) 19 Jul 1983; Notice 1, 31 July 1986;	Environmental Test Methods and Engineering Guidelines
MIL-STD-1280 28 Jan 1969	Keyboard Arrangements
MIL-STD-1388-1A(T) 11 Apr 83	Logistics Support Analysis
MIL-STD-1388-2A(T) 20 Jul 1984 Notice 1, 14 Feb 1986 Notice 2, 15 Dec 1986	Logistics Support Analysis Records
MIL-STD-1472C 10 May 1976 Notice 3 17 Mar 1987	Human Engineering Design Criteria for Military Systems, Equipment and Facilities
MIL-STD-2073-1A 16 Jul 1984	DOD Material Procedures for Development and Application of Packaging Requirements
MIL-STD-2073-2B 14 Mar 1986	Packaging Requirement Codes

<u>Other Government Aaencv Standards</u> None.

<u>Drawinas</u> None

OTHER PUBLICATIONS

AFR-36-1 Rev 1C8 Sep 1987	Officer Personnel - Officer Classification
AFR-39-1 01 Jan 1982	Enlisted Personnel - Airman Classification
AFR-80-18 09 Aug 1971	Department of Defense Engineering for Transportability
MIL-HDBK-217E 27 Oct 1986	Military Handbook Reliability Prediction of Electronic Equipment
MIL-HDBK-300 10 Oct 1981	Technical Information File of Support Equipment
MIL-HDBK-419 21 Jan 1982	Grounding, Bonding, and Shielding for Electronic Equipments and Facilities Volumes I and II
NACSIM 5203 30 Jun 1982	National COMSEC Information Memorandum: Guidelines for the Facility Design and Red/Black Installation (Confidential/NOFORN)

Interface Documents

AWS/DNXP 22 APR 1987 Change 2 30 June 1987	Interface Design Document for the Tactical Decision Aid (TDA)/ Mark IV-B Weather Data Interface
CSESD-29A OCT 1981	TSEC/KG-84(V-1): External Interface Dedicated Loop Encryption Device, KG-84 (CONFIDENTIAL)

CSESD-8J MAR 1977	TSEC/KG-43/44: Communications Security Equipment Systems Document (SECRET/NOFORN)
IS-2285557 Rev C 27 Apr 1977	Interface Specification TIROS-N Satellite - Ground System
IS-YD-812A 2 Apr 1979	Ether Interface Specification for the Block 5D-2 Configuration of the DMSP Spacecraft
IS-YD-821 15 Jan 1977 Change B	DMSP Data Specification OLS 5D-2 (including SCN 1, 5 Nov 1980; SCN 4, 8 Aug 1983; SCN 5, 1 Nov 1983)
OCR-AWDS-01 Revision 0 30 Sep 1984	System Specification for the Automated Weather Distribution System (AWDS). Interface Control Drawing, Appendix 30: UGDF/CIDE-0, Listener

GOES IJK/LM Operational Ground Equipment (OGE) Interface Specification

Doc Number: DRL 504-02
Date: 06 Oct 1988
Source: National Oceanic and Atmospheric Administration (NOAA)
National Environmental Satellite Data and Information Service (NESDIS)
Washington, D.C. 20233

Letter; Subject: Information on Planned Changes in the operation of GMS

Doc Number:JMA 86/AI/405 (Attachment 1)
Date: October 1986
Source: Japan Meteorological Agency
l-3-4 Ote-machi, chiyoda-ku, Tokyo

Meteosat System Guide - Volume 9, Meteosat High Resolution Image Dissemination

Doc Number: M.S.9.0.1.1 Issue 4
Date: August 1984
Source: European Space Agency (ESA)
Publications Division, ESTEC,
Postbus 299,NL-2200 AG Noordwijk

2.2 Non-Government Documents

The following documents form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, precedence shall be in accordance with 3.8.

<u>Standards and Specifications</u>

EIA RS-170A	Electrical Performance Standards, Monochrome Television Studio Facilities,
EIA RS-232D	Interface Between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange,
EIA-RS-310-C-77 28 Nov 77	Racks, Panels, and Associated Equipments,
ANSI/IEEE Std 488-1978 18 Jul 79	IEEE Standard Digital Interface for Programmable Instrumentation
IEEE-796	IEEE Standard Microcomputer System Bus (Referred to as MULTIBUS)
IEEE-802.3	Local Area Network CSMA/CD Access Method and Physical Layer Specification
CCITT X.25 1980	International Telegraph and Telephone Consultative Committee (CCITT) Recommendation X.25

<u>Manufacturer/Vendor Documentation</u>

AYDIN MONITOR Model 3446 Operational Specification: (Doc No. 901-0130)

AYDIN MONITOR Model 335A Operation and Maintenance Manual, Volumes I and II; June 1989

BEST POWER Options for the RM1,1.5, and 2 KVA Micro-Ferrups Models, Technical Information (TIR 136, 144, 122, 245, 350) March 1989

BEST POWER RM1-2KVA Rackmount Owner's Manual; Feb 1989

BEST POWER Owner's Installation and Operation Manual for RM1, 1.5, and 2 KVA models: Feb 1989

BEST POWER RM1-2KVA Service Manual: July 1989

BEST POWER Ferrups FC7.5, FC10, FC15KVA Owner's Manual (LTSB337); Jan 1989

BEST POWER FC7.5, FC10, FC15KVA Options Technical Information: Jan 1989

BEST POWER FC7.5, FC10, FC15KVA Service Manual: April 1989

BIT 3 Multibus I to Multibus I Adapter Model 421 Manual

CANDES User Guide For Model 7351 19" RGB Color Monitor (CONRAC)

CANDES Model 2119T 19" RGB Color Monitor Installation and Operating Instructions; April 1987

COMMUNICATION MACHINE CORPORATION MNP-30 Multifunction Node Processor Installation Guide

CONTROL DATA Wren VI ESDI Model 94196 disk drive OEM Manual: Man. 77765355, Rev A, March 1989

DATUM Operating Manual for Model 9700 Programmable Time System: Rev Nov 18,1988

DATUM Operators Manual for IEEE-488 Interface Assembly; Doc 19391, Rev C

DATUM Users Manual for Model 9390-5500 GPS Time/Frequency System; Rev Nov 1988

FOLSOM Monarch Color Graphics Converter Model 8708 Technical Manual: (P/N 8708904), July 1989

FOLSOM Monarch Color Graphics Converter Model 870862, Operating Instructions; July 1988

GENERAL DATACOMM Datacomm 9600RPA Modem operating and Installation Instructions; (Pub No. 049R181-000) Sept 1988

GENERAL DATACOMM Datacomm 224+ Modems: (Pub No. 059R112) Oct 1988

GENERAL DATACOMM Model DS-1 Instruction Manual: (Pub No. 010R310) July 1988

HEWLETT PACKARD Getting Started with the HP437B RF Power Meter, an Introductory Guide; (Doc No. 00437-900114) April 1988

HEWLETT PACKARD Operating Manual for the HP437B RF Power Meter: (Doc No. 00437-90015), Rev 1988

HITACHI Winchester Disk Drive Product Specification (K2500279) Rev. 2; Dec 1988

MASSCOMP NI-488/GPIB-796 Installation For the Masscomp MC-500 with RTU-01 (P/N 320056-01) Sept 1985

MASSCOMP GPIB Software Interface Bus Inter-active Control Program IBIC Ref. Manual (P/N 320024-01) Sept 1984

MASSCOMP IKON 10077 Hardware/Software Manual - Multibus DR11W Emulator

MICRODYNE Instruction Manual for Model 1400MR Telemetry Receiver: July 1986 & Oct 1987 Revision

MICROFRAME 386 AT Motherboard Hardware Installation and Technical Reference Manual; June 1988

MICROPOLIS Product Description 1560 Series 5.25" ESDI 760MB 15Mhz Rigid Disk Drive

NATIONAL INSTRUMENTS GPIB-796 User's Manual For Revision C Circuit cards (P/N 320010-01) April 1985

OPTELECOM Model 5000A and 5000E Rack Mounted Chassis User's Manual (P/N: UM-8J) Jan 1986

OPTELECOM System 5000 Power Supplies User's Manual (P/N: UM-8F) Oct 1987

OPTELECOM Models 5050, 5051, and 5052 High Speed Fiberoptic Analog Transmitter/Receiver Units, System 5000 Compatible (P/N: UM-25) Jan 1985

OPTELECOM Model 504x RS-423/TTL Fiber Optic Transmitter/Receiver, System 5000 Compatible (P/N: UM-31) March 1986

OPTELECOM Model 5060 RS-232 and RS-422 6-Channel Multiplexer User's Manual (P/N: UM-59) Dec 1987

OPTELECOM Model 5005A 4-Channel Interface Harness (P/N: UM-81(1)) July 1986

OPTELECOM RGB/Triple CVBS Fiber Optic Transmission System Models 3252TTT and 3252RRR and Models 5052TTT and 5052RRR (P/N: UM-56) July 1988

RADSTONE SIO-4 Intelligent Serial I/O Controller Technical Reference Manual; (Pub No. 421/HH/24937) Issue 1, Dec 1988

RACAL DANA Series 1250 Universal Switch Controller Users Manual (Man. No. 980609), Sept 1987

SEAGATE ST138R Disk Drive Product Manual: (Man No. 36045-002), Rev D, May 1989

SEIKO CH5500 Color Printers Parallel Interface Technical Specification (Doc No. C3-MTS03), March 1989

SEIKO CH5500 Color Printers Parallel Interface User's Guide (Doc No. C5-MUG02), March 1986

SEIKO CH5500 Color Printers User's QUick Reference Guide

SEIKO CH5500 Color Printers Print Engine Technical Specification (Doc No. C3-MTS01), Dec 1988

SEIKO CH5500 Color Printers Modified Centronics Parallel Interface Programming Manual (Doc No. C3-MPM01)

SIMPACT ADCCP NRM Programmer's Guide: (DC900-0115D), March 1989

STORAGE CONCEPTS Concept 51 Product Description; May 1988

STORAGE CONCEPTS Concept 51 Technical Description: Nov 1988

STORAGE CONCEPTS VME/HD/51 Host Adapter User Guide

STORAGE CONCEPTS Concept 51 Disk Processor Systems User's Guide

STORAGE CONCEPTS Concept 51 Command Description; Rev 3.14

STORAGE CONCEPTS Differential Fast Bus Interface Manual; Rev 1.0, May 1988

SUMMUS User's Installation and Operation Manual; Rev 02, April 1988

SUMMUS Interface User's Manual (Man No. IMG-002), Rev 2, Feb 1989

SUMMUS Specifications Manual (Man No. SMG-001), Rev 1, Sept 1988

SUMMUS PC User's Manual (Man No. UMGDPC-001),

SUMMUS AT Host Adapter Reference Manual (Man No. UM442ATC-001), Rev 1, March 1989

TEAC Model FD-55GFR-340/440/540 Mini Flexible Disk Drive Specification - Rev. C

TELECOMMUNICATIONS TECHNIQUES CORP Firebird 2000 and 2000-l Remote Control Manual (Doc No. ML-10491) Rev B, April 1985

TELECOMMUNICATIONS TECHNIQUES CORP Firebird 2000 Operating Manual (Doc No. ML-10220) Rev E-l, Feb 1986

WESTERN DIGITAL WD1006V-SR2 Winchester/Floppy Disk Controller; (Doc No. 79-000291), May 1988

WYSE WY-995 Intelligent Multiuser Interface Board User's Guide

XYLOGICS Model 43x Peripheral Controller User's Manual: July 1988

Lockheed - Austin Division Documents

MPS-4030B Amendment 1 20 June 1988	Protection of Electrostatic Sensitive Devices
7000831 13 April 89	System/Segment Design Document for the MARK IV-B Tactical Weather Satellite Terminals
7000833/N200 18 Aug 89	Interface Requirements Specification for the MARK IV-B Tactical Weather Satellite Terminals
7000834/A100 22 June 1989	Software Requirements Specification for the Antenna CSCI of the MARK IV-B Tactical Weather Terminals System
7000835/B100 22 June 1989	Software Requirements Specification for the Input CSCI of the MARK IV-B Tactical Weather Terminals System
7000836/C100 22 June 1989	Software Requirements Specification for the Product CSCI of the MARK IV-B Tactical Weather Terminals System
7000837/D100 22 June 1989	Software Requirements Specification for the Data Archive CSCI of the MARK IV-B Tactical Weather Terminals System
7000839 11 Aug 1989	Interface Specification for the MARK IV-B Tactical Weather Satellite Terminals with the Satellite Imagery Dissemination System (SIDS)

3. REQUIREMENTS

3.1 MARK IV-B Prime Item Definition

The MARK IV-B Tactical Weather Satellite Terminals, herein called the System, will consist of the equipment, facilities, and software as specified in the following paragraphs.

3.1.1 MARK IV-B Diagrams

The System is represented in the series of block diagrams in this section. The System overview is shown in Figure 1. The System hierarchy is shown in Figure 2. The Pointing Antenna, which receives the Geostationary Satellite data is shown in Figure 3. The Tracking Antenna, which receives the Polar Satellite data is shown in Figure 4. The Acquisition Equipment, which receives the Geostationary and Polar Satellite data from the antenna and processes it into a form that is useful to the Input Computer is shown in Figure 5 (460). The Antennas along with the Acquisition Equipment make up the RF front end, for satellite signal reception, for the MARK IV-B System (450). The System also receives timing signals from the NAVSTAR GPS satellites. The Input Computer, which processes and stores the satellite imagery/data for use by the Product Computer, is shown in Figure 6. The Product Computer, which processes, stores and outputs the satellite imagery/data and related products under control of user/operator commands, is shown in Figure 7. The User Station, which is the user interface with the System, is shown in Figure 8.

The system hierarchy is defined for the purpose of the drawing package for the system. The equipment shown in Figure 3 and Figure 4 make up to Antenna Group of the Acquisition Subsystem. The equipment in Figure 5 is the Processing Group of the Acquisition Subsystem. The Input Subsystem is shown in Figure 6. The Computer Group of the Product Subsystem is shown in Figure 7. The Workstation Group is shown in Figure 8.

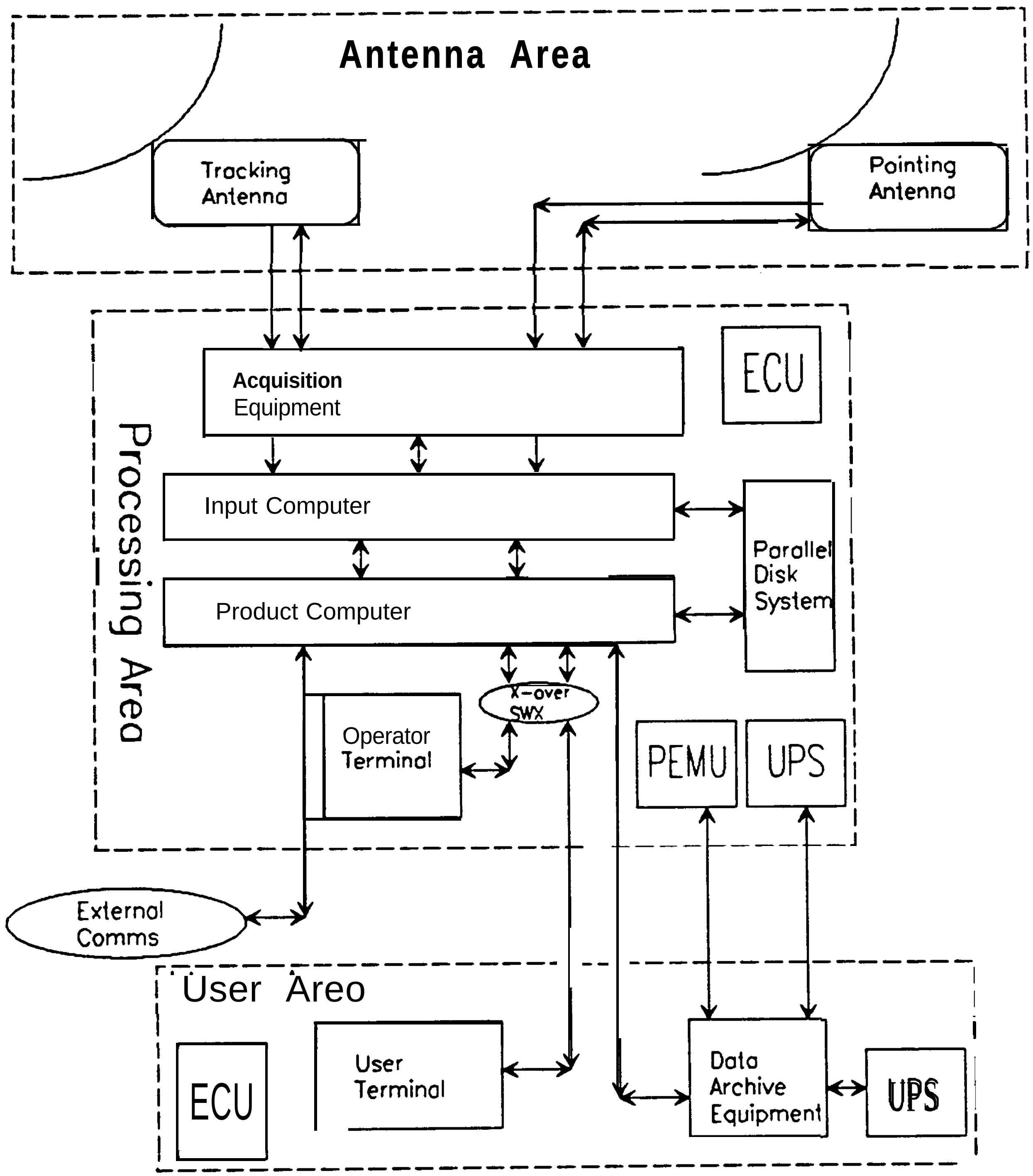


Figure 1 – Mark IVB Fixed Site System Functional Block Diagram

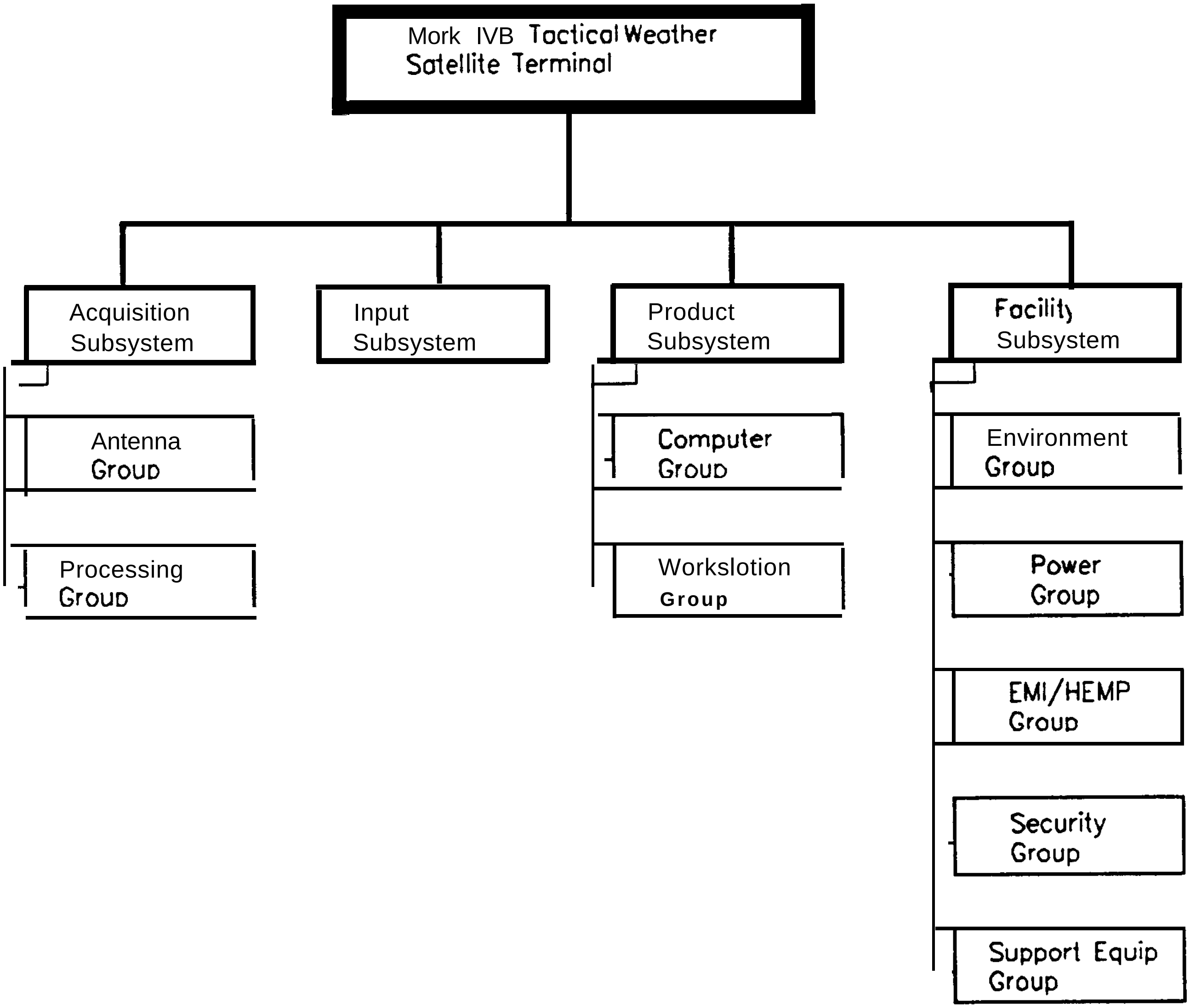


FIGURE 2
Mark IVB System Hierarchy

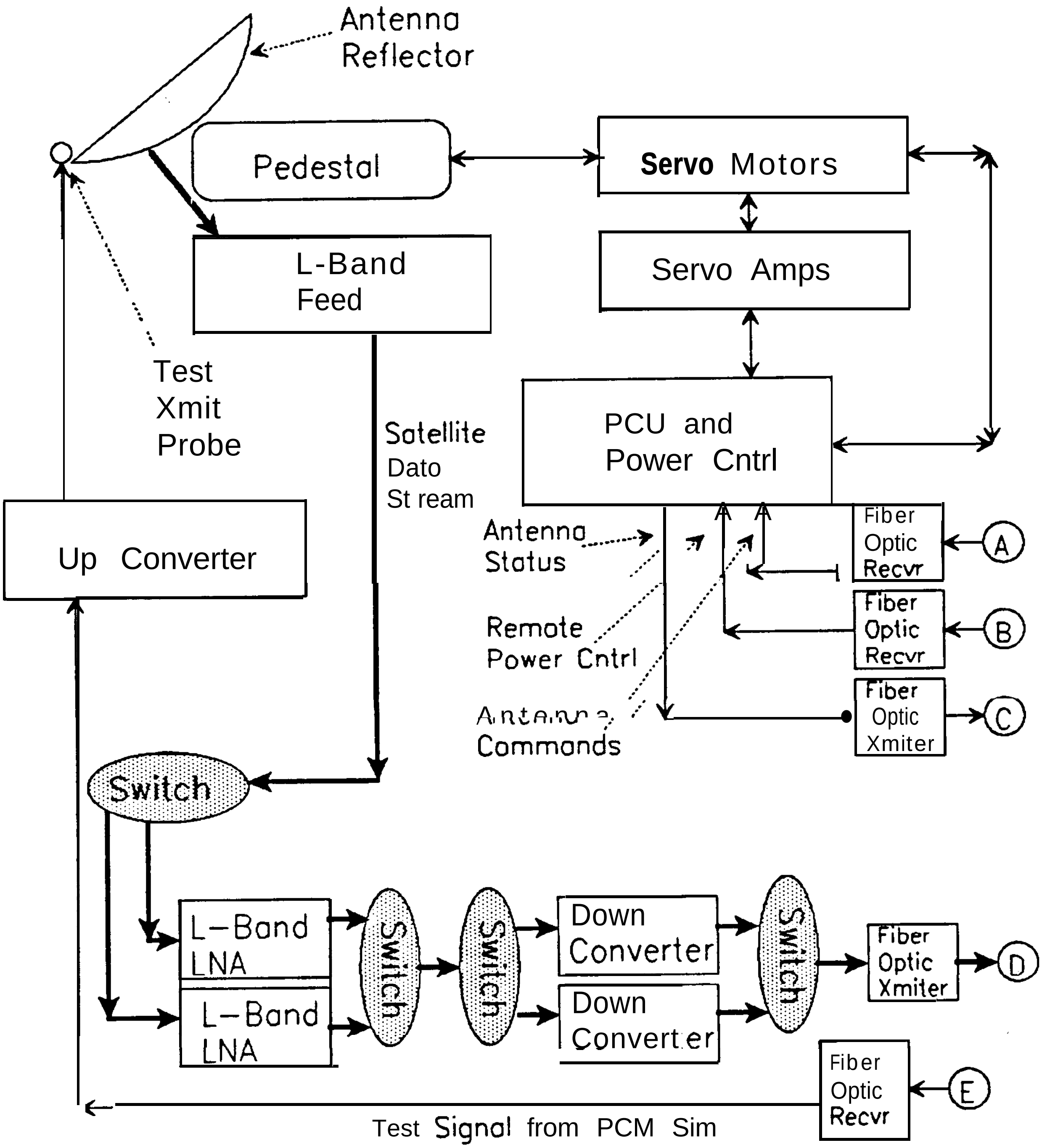


FIGURE 3
Pointing Antenna Block Diagram

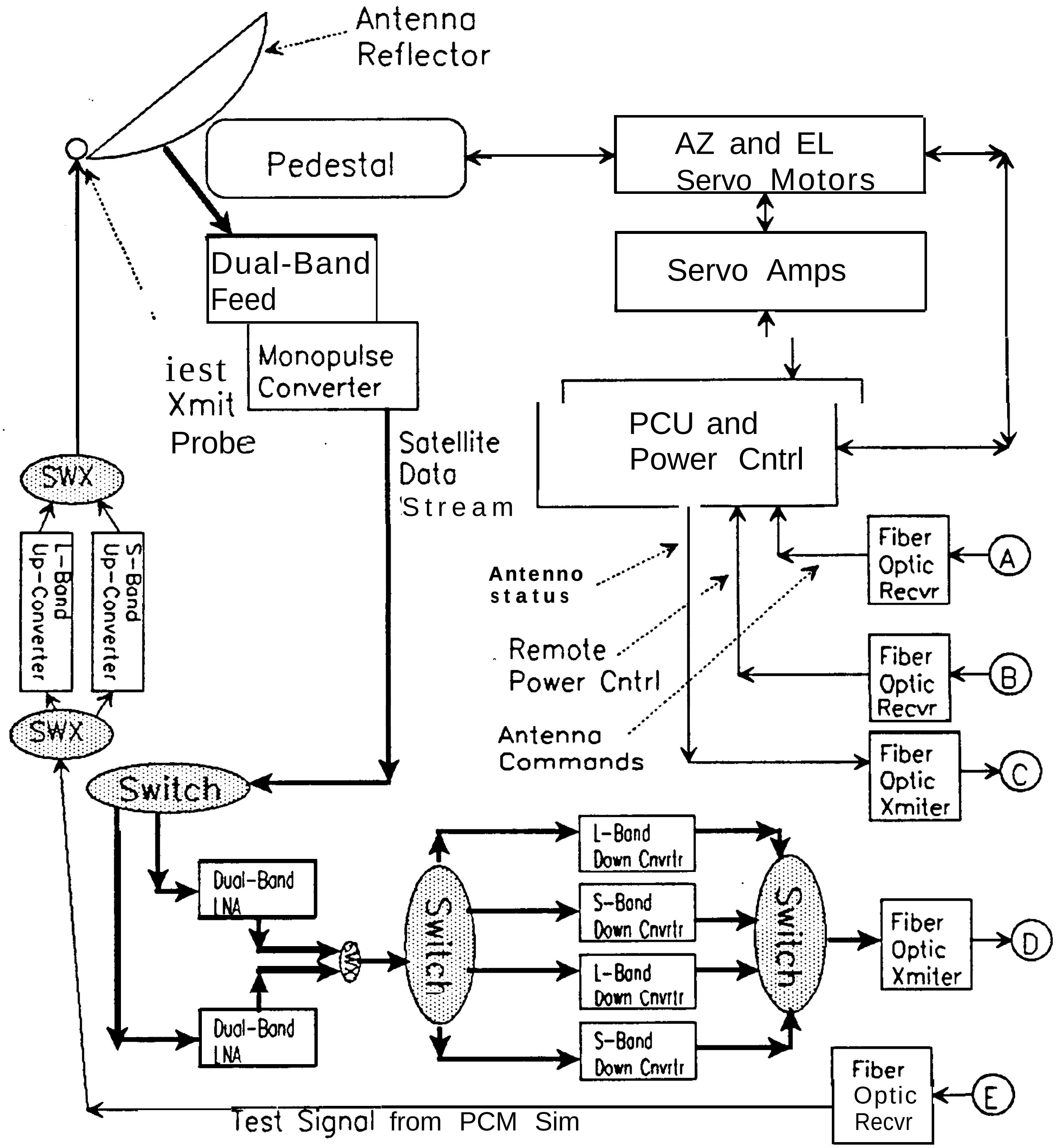


FIGURE 4
Tracking Antennu Block Diagram

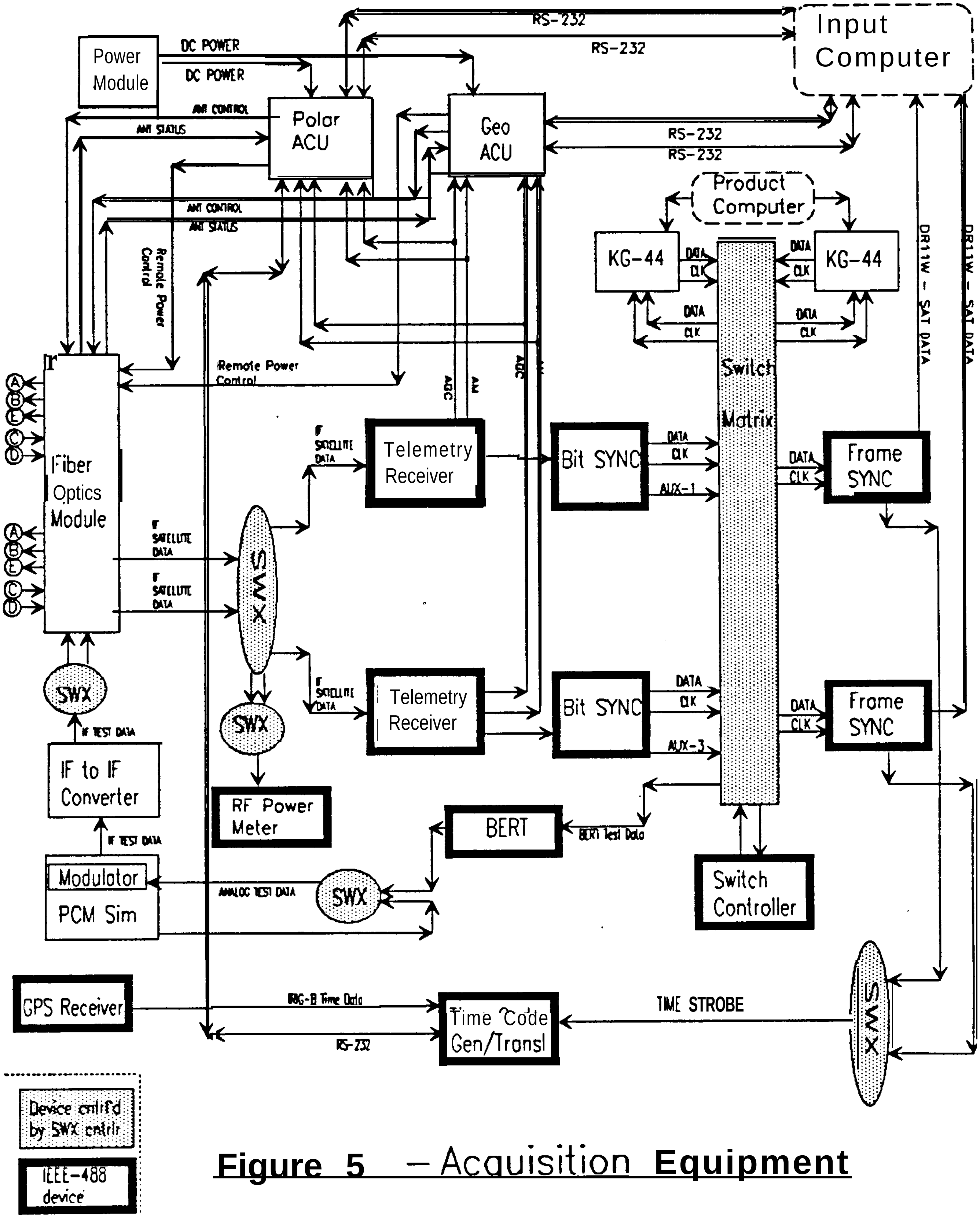
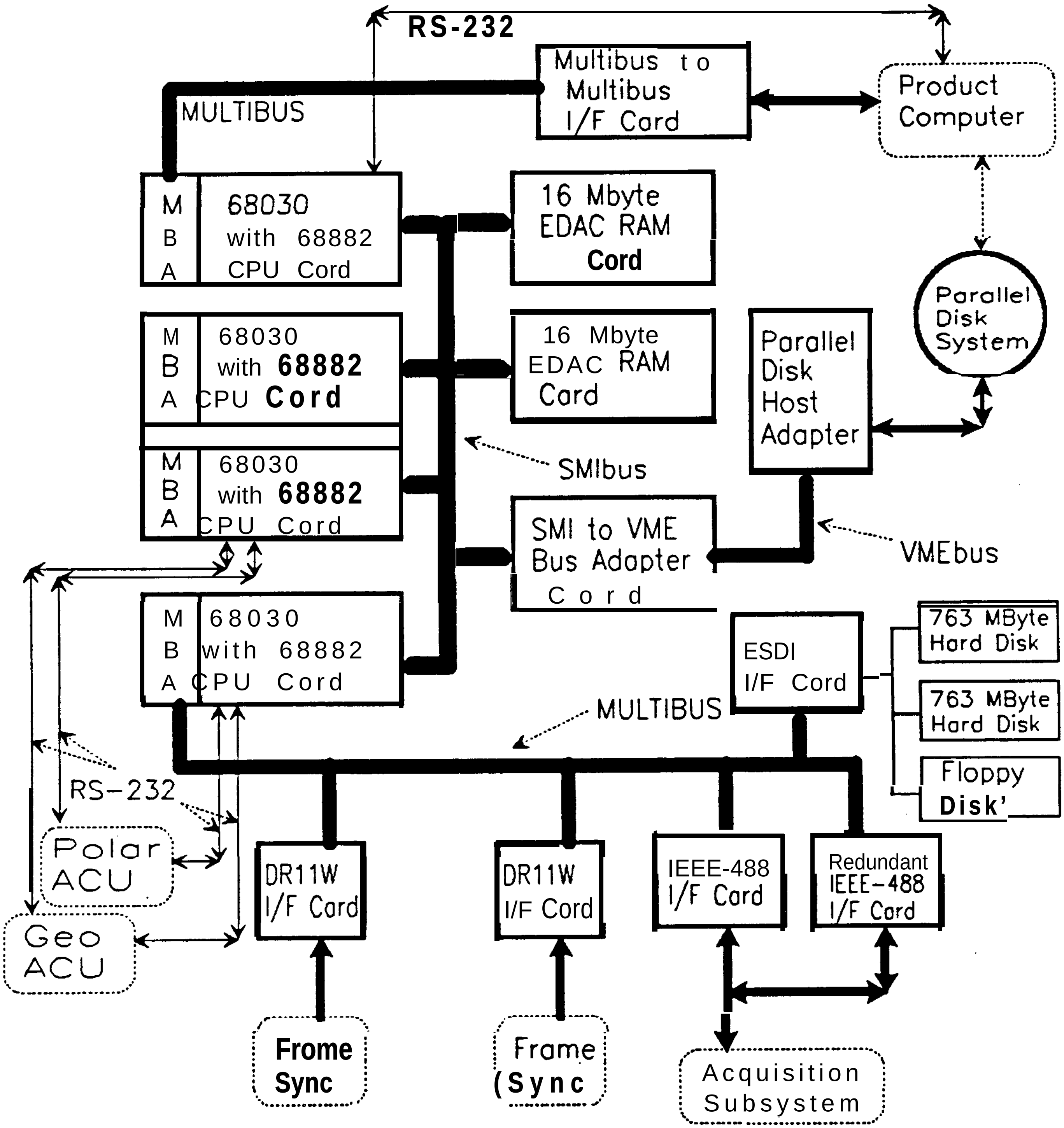
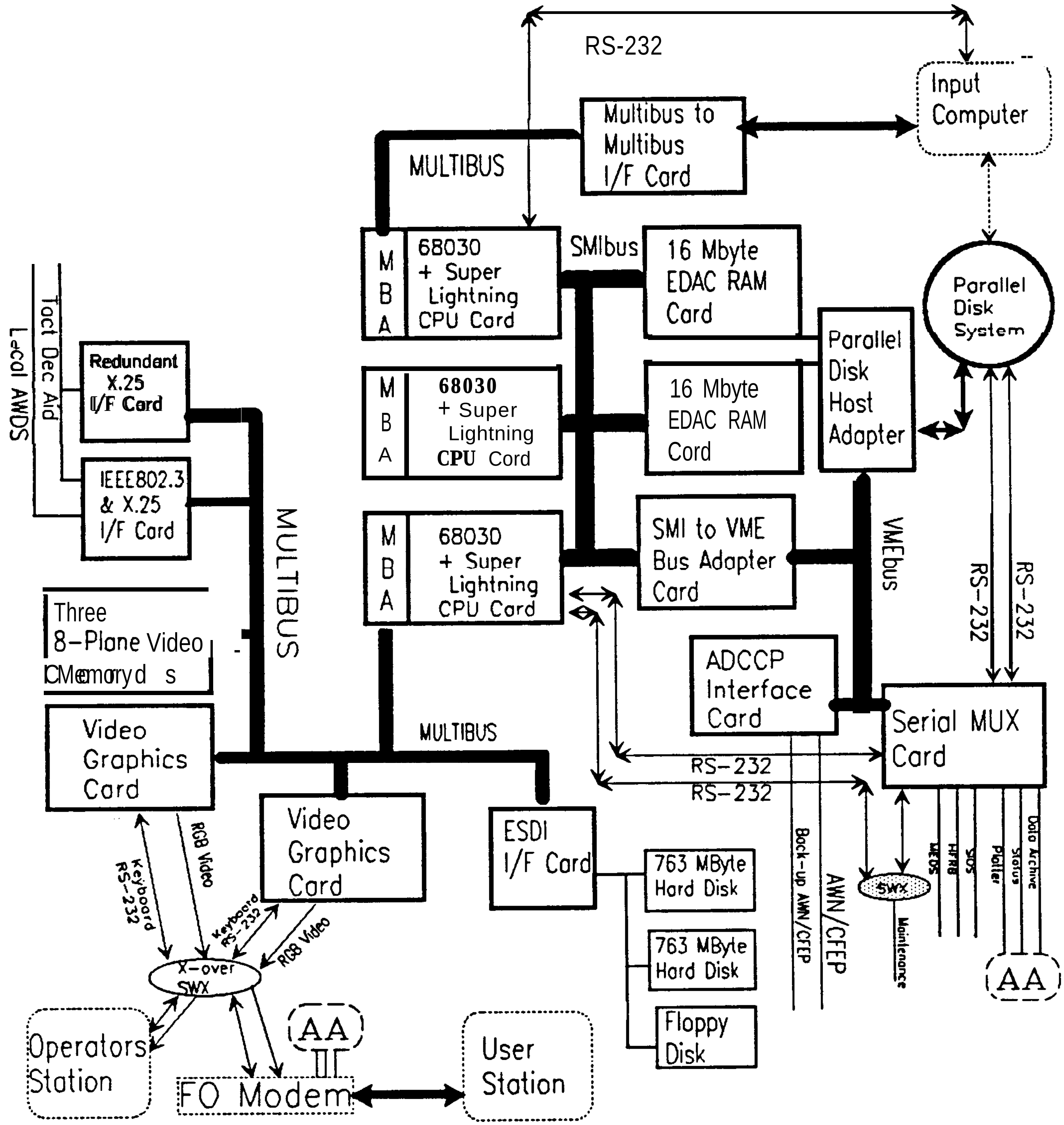


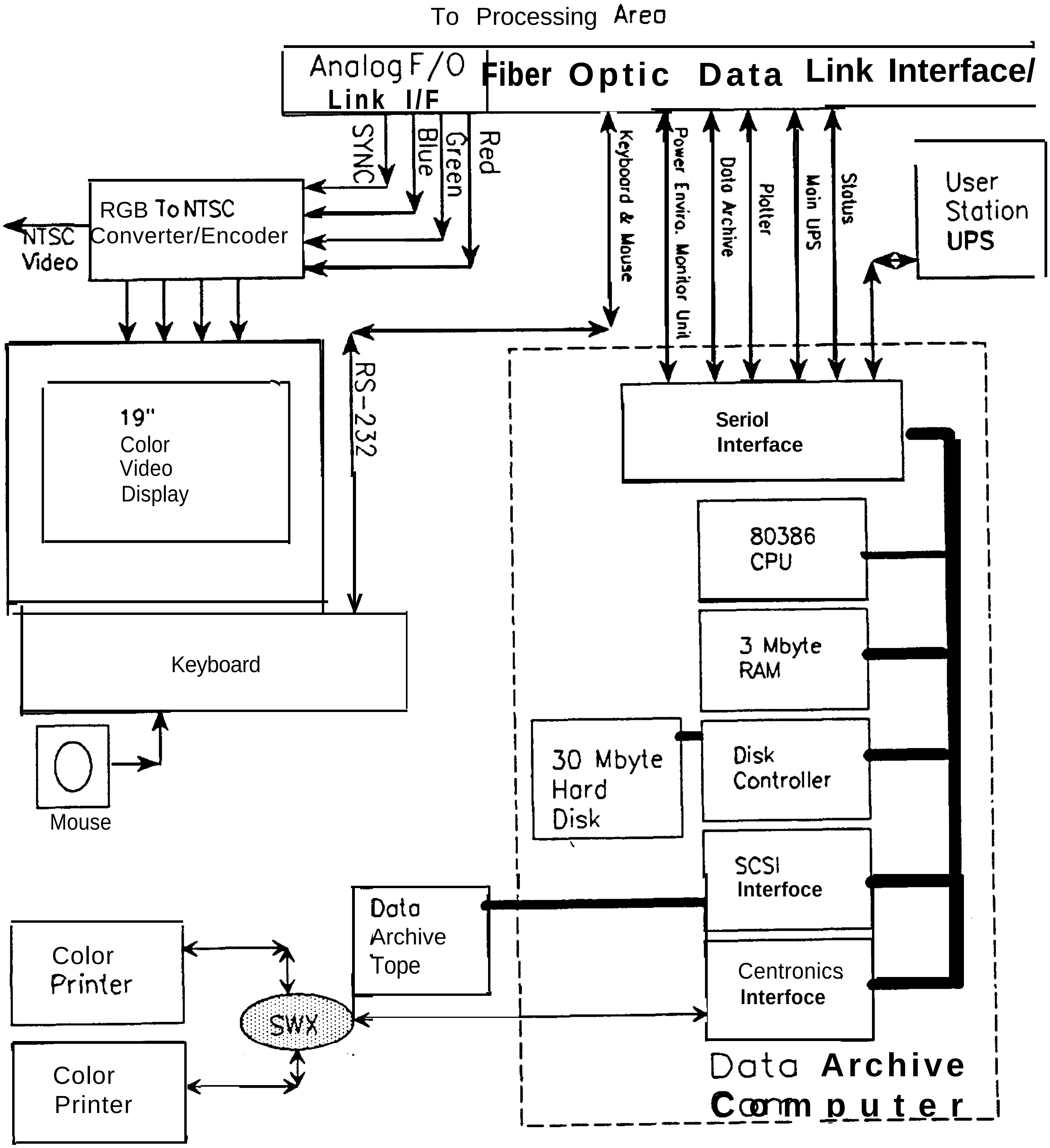
Figure 5 — Acquisition Equipment



Fiaure 6 – Input Computer Subsystem



Fiaure 7-Product Computer Subsystem



Fiaure 8 – User Station Block Diagram

3.1.2 Interface Definitions

The functional and physical interfaces will be as described in the following paragraphs.

3.1.2.1 Functional Interfaces

The functional interfaces are divided into the internal and the external interfaces. The functional interfaces within the system are described in 3.1.2.1.1 and subparagraphs. The functional interfaces between the system and equipment external to the system are described in 3.1.2.1.2 and subparagraphs.

3.1.2.1.1 Internal Functional Interfaces

The internal functional interfaces are described in the following paragraphs.

3.1.2.1.1.1 Antenna to Acquisition Equipment Interfaces

The system contains two satellite antenna assemblies, a tracking antenna for the Polar Satellite reception, and a pointing antenna to receive Geostationary Satellite data. The functional interfaces from the two antennas to the Acquisition Equipment in the Processing Area are the same. All interfaces to the antenna except the power, use fiber optics as the transmission media. The antennas can be located up to 1500 feet from the processing area (1600). The interfaces between the antennas and the processing area are diagrammed in Figure 9. The block diagram of the pointing antenna is shown in Figure 3. The block diagram for the tracking antenna is shown in Figure 4. The block diagram for the Acquisition Equipment is shown in Figure 5. The functional interfaces are described in the following paragraphs.

All the signal interfaces between the Antennas and the Acquisition Equipment are transmitted via fiber optic transmitter and receiver pairs. The fiber optic link is transparent to the signal/data being sent and therefore will not be mentioned in the following subparagraphs.

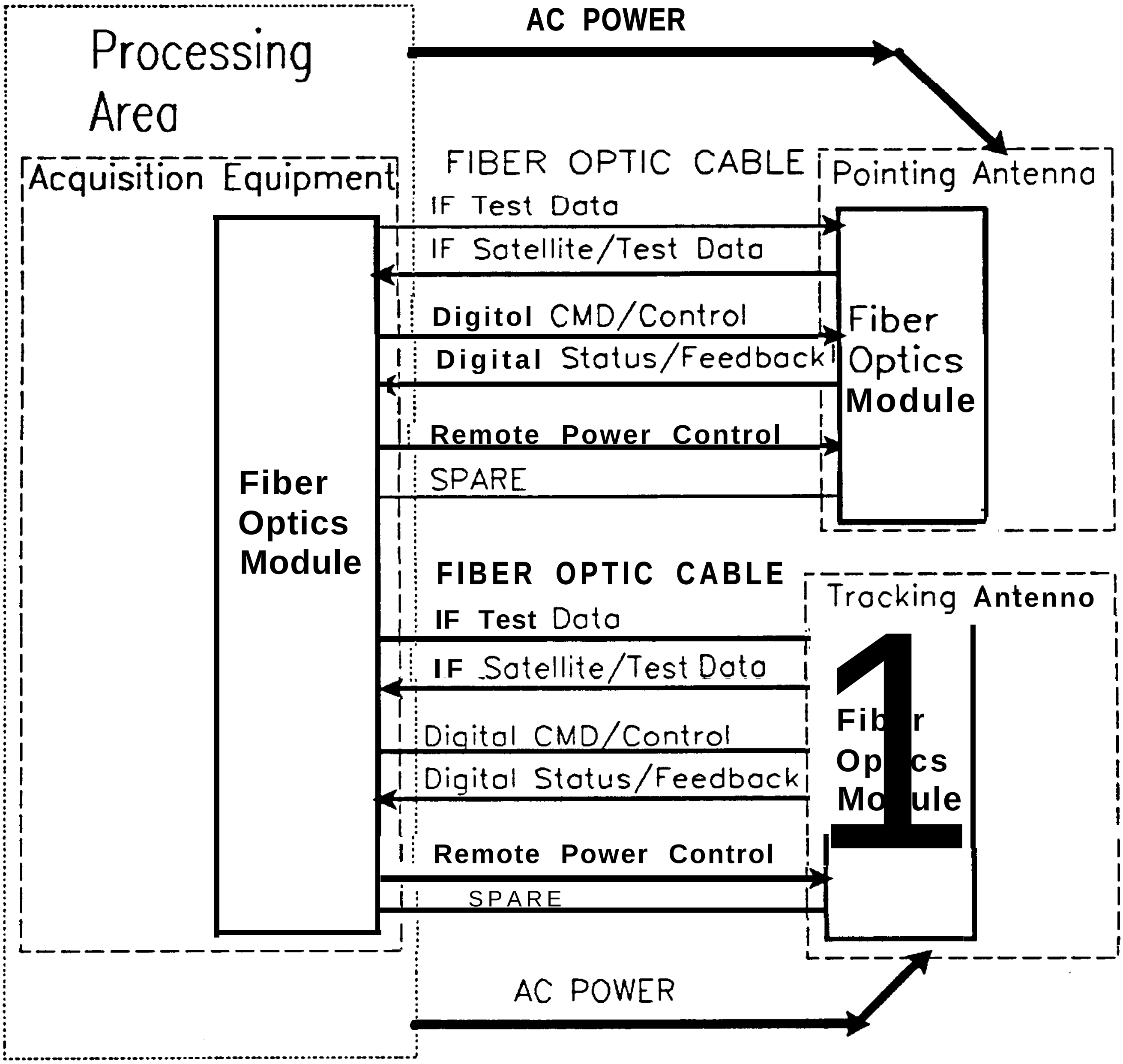


FIGURE 9 – Processing Area to Antenna Interfaces

3.1.2.1.1.1.1 Pedestal Control Unit to Antenna Control Unit Interfaces

The motion of the antenna reflector is controlled by the Pedestal Control Unit (PCU) at the antenna pedestal. The Antenna Control Unit (ACU), at the Processing area, commands the PCU to control the motion of the antenna reflector to a desired path. The configuration of the switches in the antenna assemblies shown in Figures 3 and 4 is also controlled by the PCU, and commanded by the ACU. The interface that transfers these commands and returns status information is a serial asynchronous data stream conforming to EIA RS-232D standards. The baud rate of this interface is 9600 BPS. The interface is bidirectional with commands being sent to the PCU from the ACU, and status data being sent back.

3.1.2.1.1.1.2 Down Converter to Acquisition Equipment Interface

The data received from the satellite is down-converted to an Intermediate Frequency (IF) and is then sent to the Acquisition Equipment via a fiber optic cable. Within the processing area, a 50 Ohm coaxial cable is used for the interconnection to either the Telemetry Receiver or the RF Power Meter. The IF data is in the frequency range of 215 to 320 Mhz. The format of the data contained on this interface is unique for each of the six satellite data formats that the MARK IV-B receives. The format of each is defined in 3.1.2.1.2.1 .

3.1.2.1.1.1.3 IF to IF Converter to Antenna Up Converter Interface

The Acquisition Equipment contains a PCM Data Simulator and a Bit Error Rate Tester (BERT) that upon selection will generate an analog test pattern that will be fed through a modulator (internal to the PCM simulator) which feeds the' IF to IF Converter. The output of the IF to IF Converter is a 240 Mhz Intermediate Frequency modulated signal that interconnects to the selected (Geo or Polar) Fiber Optics

Module using a 50 Ohm Coaxial cable. Fiber Optics are used to interface this data path from the processing area to the Antenna area. Within the Antenna area, a 50 Ohm Coaxial cable will interface the IF data to the selected Up-Converter.

3.1.2.1.1.1.4 Antenna Control Unit to Antenna Power Module Interface

At MARK IV-B System power-up, the Power/Environment monitoring Unit (PEMU) signals the Acquisition Equipment Power Module to apply the appropriate voltages to the ACUs. Each ACU then signals the respective Antenna Area Power Module which will provide power to all the antenna electronics. The interface from the Processing Area to the Antenna Area is via Fiber Optic Cables. The electrical format of this interface is standard TTL (0-5Vdc) where high is on and low is off.

3.1.2.1.1.2 Acquisition Equipment Internal Functional Interfaces

The functional interfaces within the Acquisition subsystem are described in this section.

3.1.2.1.1.2.1 Antenna Control Unit Functional Interfaces

The functional interfaces of the ACU are described in this section.

3.1.2.1.1.2.1.1 Antenna Control Unit to Telemetry Receiver-AGC Interface

The ACU monitors the AGC output of the Telemetry Receiver for use in the Auto-tracking mode of operation. The AGC signal is 0 to 8 Vdc. The interface medium is a 50 Ohm Coaxial cable.

3.1.2.1.1.2.1.2 Antenna Control Unit to Telemetry Receiver-AM Interface

The ACU monitors the AM output of the Telemetry Receiver for use in the Auto-tracking mode of operation. The AM signal is contained is a 2 Volt Peak to Peak envelope. The interface medium is a 75 Ohm Coaxial cable.

3.1.2.1.1.2.1.3 Polar Antenna Control Unit to Time Code Generator/Translator Interface

The Polar ACU interfaces to the Time Code Generator/Translator to receive time data for use during the program track operation. This interface conforms to EIA RS-232C specifications, and has a baud rate of 9600.

3.1.2.1.1.2.2 Telemetry Receiver to Bit Synchronizer Interface

The telemetry receiver demodulates the incoming satellite (IF) data stream and outputs the analog (Video) data stream to the Bit Synchronizer. The data rate of this stream is dependent on which of the satellite formats the receiver is processing. The data is contained in a 0.5 to 30 V Peak to Peak signal. The interface medium is a 50 Ohm Coaxial cable.

3.1.2.1.1.2.3 Bit Synchronizer to Frame Synchronizer Interface

The Bit Synchronizer processes the analog (video) data stream that it receives from the telemetry receiver and outputs a digital stream to the Frame Synchronizer. This digital stream is transmitted as two signals on two separate lines, Data, and Clock. The data rate of this stream is dependent on which satellite format is being processed. The Data is contained in a 0 to 3.5 volt NRZ-L signal. The Clock is contained in a 0 to 3.5 volt RZ signal. The interface medium is a 50 Ohm Coaxial cable.

3.1.2.1.1.2.4 KG-44 Interfaces

If the Switch Matrix is configured to route the Satellite data through the KG-44 for decryption, the KG-44 is inserted between the Bit Synchronizer and the Frame Synchronizer via automatic software controlled switching. It receives the encrypted Data and Clock from the Bit Synchronizer, and outputs the decrypted Data and Clock to the Frame

Synchronizer. The Data and Clock signal description is identical to the output of the Bit Synchronizer as stated in 3.1.2.1.1.2.3. The data path from the Bit Synchronizer to the Switch Matrix is made by a 50 Ohm Coaxial Cable. The interconnections to the switch matrix are also 50 Ohm. The input and output ports of the KG-44 are at 93 Ohm using a Coaxial interface medium.

The KG-44 will have the address and response registers set remotely from the product computer.

3.1.2.1.1.2.5 Switch Matrix Interfaces

The Switch Matrix is a computer controlled automatic patch panel, that does not effect the signals that are routed through it. The signals entering the unit are routed through a matrix of switches, under the control of the switch controller, and exits the matrix at the specified connection point. The routing of the signal through the matrix is transparent to the devices at the input point and the output point. The Switch Matrix interfaces with digital, analog, and IF signals at 50 Ohm using coaxial cables.

3.1.2.1.1.2.6 Frame Synchronizer to Time Code Generator/Translator

The Frame Synchronizer outputs an event time strobe to the time code generator/translator which marks and logs an event time. The strobe represents the receipt time of a line of polar satellite data. The strobe consists of a low level voltage pulse and the interface medium is a 50 Ohm coaxial cable.

3.1.2.1.1.2.7 GPS Receiver to Time Code Generator/Translator

The GPS receiver outputs an IRIG-B compatible time signal to the Time Code Generator/Translator. This time signal is of the IRIG-B format and the interface medium is a 50 Ohm Coaxial cable.

3.1.2.1.1.2.8 Bit Synchronizer to Bit Error Rate Tester Interface

During a Bit Error Rate Test, the Bit Error Rate Tester (BERT) receives the test pattern from the Bit Synchronizer for the measurement of the Bit Error Rate. The AUX output from the Bit Synchronizer is providing the test pattern. The interface medium for this interface is a 50 Ohm coaxial cable.

3.1.2.1.1.2.9 Bit Error Rate Tester to IF Modulator Interface

The BERT is used for testing the Acquisition subsystem in a Closed Loop End-to-End Acquisition test. The BERT outputs a test pattern of data to the IF Modulator (internal to the PCM data simulator) for use during a Bit Error Rate Test. The transmission medium for this interface is a 50 Ohm Coaxial cable. This pattern of data is output in an analog/video signal similar to the signal between the Telemetry Receiver and the Bit Synchronizer, and will be modulated on the appropriate IF carrier. The IF Modulator performs the initial IF modulation of this data. This data is input through the RF and IF section of the Acquisition equipment and is fed back into the BERT for the measurement of the Bit Error Rate.

3.1.2.1.1.2.10 Pulse Code Modulation Data Simulator to IF Modulator Interface

The Pulse Code Modulation (PCM) Simulator is used for testing the Acquisition subsystem in an Open Loop End-to-End Acquisition test. The PCM simulator outputs a test pattern of data that is fed through the entire Acquisition subsystem and is received by the Input Computer via the Frame Synchronizer. This pattern of data is output in an analog/video signal similar to the signal between the Telemetry Receiver and the Bit Synchronizer, and will be modulated on the appropriate IF carrier using a IF modulator internal to the unit. The IF Modulator performs an initial IF modulation of this data. During the Open Loop End-to-End test, this pattern is then analyzed by the Input CSCI and the results of the test are then displayed to the Operator/User.

3.1.2.i.1.2.11 PCM Simulator/IF Modulator to IF/IF Converter Interface

The IF Modulator outputs a modulated signal to the IF to IF Converter for re-modulation, to a 240 Mhz IF frequency. The transmission medium for this interface is a 50 Ohm Coaxial cable. The IF to IF Converter then outputs that signal to the Antenna assemblies (Up Converters).

3.1.2.1.1.3 Acquisition Equipment to Input Computer Interfaces

The Acquisition Equipment outputs the received satellite and/or test data along with status data to the Input Computer, and receives commands for configuration and control from the Input Computer. The Acquisition Equipment consists of two sets of receiving components, one for the polar, and one for the geostationary satellite data streams. These two sets of components are identical, except for a minor difference in the ACUs, and are described in the following paragraphs as a common component between the two paths. There are three internal interfaces which allow the Acquisition Equipment to communicate to the Input Computer: IEEE STD 488-1978, RS-232C, & DR11W.

3.1.2.1.1.3.1 IEEE STD 488-1978

The primary command, control, and status interface between the Acquisition Equipment and the Input Computer is an IEEE-488 bus. This bus conforms to the ANSI/IEEE STD 488-1978, IEEE Standard Digital Interface for Programmable Instrumentation 488 specification. The equipment that is interfaced via this bus are shown in Figure 5. The interfaces to each of the components of the Acquisition Equipment are described in the following sub-paragraphs.

a. Input Computer to Telemetry Receiver Interfaces

The Acquisition Subsystem contains two Telemetry Receivers, both interfacing to the IEEE-488 bus. The Input Computer sends commands to the designated Telemetry Receiver that initializes or changes the setup of the unit and requests status'from it periodically. The protocol of the messages being transferred is defined in the document;
MICRODYNE Instruction Manual for Model 1400R Telemetry Receiver; July 1986 & Oct 1987 Revision.

The Input CSCI software, resident in the Input Computer, that initializes the unit and monitors the status data is described in the Input Software Requirements Specification (SRS) LMSC-7000835/B100. The data transferred via this interface is defined in the Interface Requirements Specification (IRS) LMSC-7000833/N200.

b. Input Computer to Bit Synchronizer Interfaces

The Acquisition Subsystem contains two Bit Synchronizers, both interfacing to the IEEE-488 bus. The Input Computer sends commands to the designated Bit Synchronizer that initializes or changes the setup of the unit and requests status from it periodically. The Input CSCI software, resident in the Input Computer, that initializes the unit and monitors the status is described in the Input SRS LMSC-7000835/B100. The data transferred via this interface is defined in the IRS LMSC-7000833/N200.

c. Input Computer to Frame Synchronizer Interfaces

The Acquisition Subsystem contains two Frame Synchronizers, both interfacing to the IEEE-488 bus. Each Frame Synchronizer interfaces to the Input Computer via two interfaces, the IEEE-488 bus, and a DR11W parallel interface. The IEEE-488 interface is discussed below, while the DR11W interface is discussed in 3.1.2.1.1.3.3 .

The Input Computer sends commands to the designated Frame Synchronizer that initializes or changes the setup and requests status from it periodically. The protocol of the messages being transferred is defined in the document:

AYDIN MONITOR Model 3446 Operational Specification: (Doc No. 901-0130).

The Input CSCI software, resident in the Input Computer, that initializes the unit and monitors the status data is described in the Input SRS LMSC-7000835/B100. The data transferred via this interface is defined in the IRS LMSC-7000833/N200.

d. Input Computer to GPS Receiver Interface

The Input Computer sends commands to the GPS Receiver that initializes or changes the setup of the unit and requests status, and/or time data from it periodically. This interface is part of the IEEE-488 bus. The Input CSCI software, resident in the Input Computer, that initializes the unit and monitors the status data is described in the Input SRS LMSC-7000835/B100. The data transferred via this interface is defined in the IRS LMSC-7000833/N200.

e. Input Computer to Time Code Translator Interface

The Input Computer initializes the Time Code Translator configuration and requests status from it periodically. This interface is part of the IEEE-488 bus. The protocol of the messages being transferred is defined in the document:

DATUM Operating Manual for Model 9700 Programmable Time System; Rev Nov 18,1988.

The Input CSCI software, resident in the Input Computer, that initializes the unit and monitors .the status data is described in the Input SRS LMSC-7000835/B100. The data transferred via this interface is defined in the IRS LMSC-7000833/N200.

f. Input Computer to Switch Controller Interface

The Input Computer interfaces to the Switch Controller via a IEEE-488 bus. The Input Computer sends commands to the Switch Controller to initialize and control the Switch Matrix configuration, and requests status from it periodically. This interface is part of the IEEE-488 bus. The protocol of the messages being transferred is defined in the document;

RACAL DANA Series 1250 Universal Switch Controller Users Manual (Man. No. 980609), Sept 1987.

The Input CSCI software, resident in the Input Computer, that commands the unit and monitors the status data is -described in the Input SRS LMSC-7000835/B100. The data transferred via this interface is defined in the IRS LMSC-7000833/N200.

g. Input Computer to Bit Error Rate Tester Interface

The Input Computer sends commands to the Bit Error Rate Tester (BERT) that initializes or changes the setup of the unit and requests status from it periodically during Closed Loop End to End Acquisition subsystem testing. This interface is part of the IEEE-488 bus. The protocol of the messages being'transferred is defined in the manuals:

TELECOMMUNICATIONS TECHNIQUES CORP Firebird 2000 and 2000-l Remote Control Manual (Doc No. ML-10491) Rev B, April 1985.

and

TELECOMMUNICATIONS TECHNIQUES CORP Firebird 2000 and 2000-l Remote Control Manual (Doc No. ML-10491) Rev B, April 1985.

The Input CSCI software; resident in the Input Computer, that initializes the unit and monitors the status data is described in the Input SRS LMSC-7000835/B100. The data transferred via this interface are defined in the IRS LMSC-7000833/N200.

h. Input Computer to RF Power Meter Interface

The Input Computer sends commands to the RF Power Meter that initializes or changes the setup of the unit and requests status from it periodically during acquisition subsystem testing. This interface is part of the IEEE-488 bus. The protocol of the messages being transferred is defined in the manual;

HEWLETT PACKARD Getting Started with the HP437B RF Power Meter, an Introductory Guide; (Doc No. 00437-900114) April 1988.

The Input CSCI software, resident in the Input Computer, that initializes the unit and monitors the status data is described in the Input SRS LMSC-7000835/B100. The data transferred via this interface is defined in the IRS LMSC-7000833/N200.

3.1.2.1.1.3.1.1 Electronic Requirements
The IEEE STD 488-1978 is a precisely defined scheme that makes use of digital techniques to interconnect a variety of electronic equipment. This bus shall use standard LS-TTL logic levels where 2.6 to 5 volts dc is a logic 1 and 0 to 0.6 volt dc is a logic 0. The bus shall transfer 8 bits (1-byte) of data, in parallel form, per transfer. All data transfers will be controlled by LS-TTL signals presented on one or more of the three bus control lines. Each of the control lines has its own associated ground line. Five other lines carrying LS-TTL signals are for bus management, three of which have their own ground lines. In addition, there is a shield ground and a common signal ground.

3.1.2.1.1.3.1.2 Physical and Mechanical Requirements
As defined by the IEEE STD 488-1978 the bus is a cable of 24 wires. The maximum length of the bus is 20 meters and has a maximum capacity of 15 devices - including the controlling device.

3.1.2.1.1.3.2 RS-232C
There are four RS-232C interfaces which allow for communications between the Input computer and the Polar Antenna Control Unit (ACU) and the Geostationary ACU. Two RS-232C lines (one active and the other inactive) are used for the Polar ACU and two (one active and the other inactive) for the Geostationary ACU. This interface redundancy (four vice two) is in place to enhance the reliability of the interface.

During system initialization/power-up this interface is used to down load the Antenna CSCI from the Input Computer to the ACU, and to get the power-up Built In Test (BIT) results from the ACU to the Input computer. The Input Computer sends commands and Antenna Control Information to the ACU that change the setup/operation of the unit and requests status from it periodically. It will also pass antenna position and configuration status information from the antenna controllers back to the Input Subsystem.

This interface is an asynchronous serial link conforming to EIA RS-232D standards. The software resident in the ACU, the Antenna CSCI, is described in the Antenna SRS LMSC-7000834/A100. The Input CSCI software, resident in the Input Computer, that initializes the unit and monitors the status and antenna positioning data is described in the Input SRS LMSC-7000835/B100. The data transferred via this interface are defined in the IRS LMSC-7000833/N200.

3.1.2.1.1.3.2.1 Electronic Requirements

The RS232C interface consists of a single line for transmitting serial data, a single line for receiving serial data, and a pair of handshake lines all referenced to a common ground line. A voltage level of +3 to +15 volts DC is used to represent a digital 1 and a voltage level of -3 to -15 volts DC to represent a digital 0. When the interface is unloaded the maximum voltage is þ25 volts DC. The maximum capacitance of the interface is specified as 2500 picofarads or 50 picofarads per foot, and the maximum impedance at the terminating end is 7000 Ohm.

3.1.2.1.1.3.2.1 Physical and Mechanical Requirements

The RS232C interface has a maximum of 22 signals,typically terminated at both ends with 25-pin connectors. However, only 5 of the signals are used by the Acquisition Subsystem to Input Subsystem interface. The maximum recommended length of the interface is specified as 50 feet.

3.1.2.1.1.3.3 DR11W

There are two DR11W interfaces which allow for the satellite data transfer between the Frame Synchronizer and the Input Computer. One DR11W interface is used to transfer data for a particular pass (Polar or Geostationary) or for an Open

Loop End-to-End Acquisition test. The interface to be used is selected by the User.

The DR11W is a high speed 16-bit parallel, serial by word, general purpose Direct Memory Access (DMA) interface. This interface will transfer the formatted Polar or Geostationary satellite data from the Frame Synchronizer to the Input Computer. The Input CSCI software, resident in the Input Computer, that initializes the unit and monitors the status as well as receiving the satellite data, is described in the Input SRS LMSC-7000835/B100. The Frame Synchronizer partially unpacks and formats the satellite data to ease the real-time processing required by the Input computer. The format and protocol of the data transferred via this interface is defined in the IRS LMSC-7000833/N200. The DR11W is a widely used interface first introduced by Digital Equipment Corporation. The DR11W has been adopted as an informal industry standard with a large number of computer manufacturers supporting it.

3.1.2.1.1.3.3.1 Electronic Requirements

The DR11W uses standard TTL devices for input receivers and output drivers. The input data and control lines are one standard TTL unit load each. The output data and control lines can drive up to 10 standard TTL unit loads each. A logic one is represented by a voltage level of 2.6 to 5 volts DC and a logic zero is a voltage level of 0 - 0.6 volt DC. The maximum data transfer rates are 250,000 16-bit words per second in single cycle mode and 400,000 16-bit words per second in burst mode. However, when in continuous burst mode other devices will be locked out of the bus while the transfers are ongoing.

3.1.2.1.1.3.3.2 Physical and Mechanical Requirements

The DR11W interface consists of 80 single ended lines. The maximum length of the interconnection cable is 20 feet.

3.1.2.1.1.4 Input Computer to Product Computer Interfaces

The interfaces between the Input and Product Computer will be as described in the following paragraphs.

3.1.2.1.1.4.1 Input Computer to Product Computer Multibus to Multibus Interface

The Input and Product computers will communicate via a software transparent Multibus to Multibus interface. The interface board in the Product computer will include 1Mbyte of local dual-ported RAM onboard to allow the transfer of data between the computers without needing access to the Multibus. This interface will support data transfer rates approaching the transfer rate of the Multibus itself (4 Mbyte/Sec). The Input CSCI software, resident in the Input Computer, that initializes the board residing in the Input computer, monitors the status of it, and transfers data via it is described in the Software Requirements Specification (SRS) LMSC-7000835/B100. The Product CSCI software, resident in the Product Computer, that initializes the board residing in the Product computer, monitors the status of it, and transfers data via it is described in the SRS LMSC-7000836/C100. The data transferred via this interface are defined in the Interface Requirements Specification (IRS) LMSC-7000833/N200.

3.1.2.1.1.4.2 Input Computer to Product Computer RS-232 Serial Interface

The Input Computer master CPU will be linked to the Product Computer via a RS-232D asynchronous serial link operating at 9600 baud. This link is used for system start-up and initialization. It will also be used in case of some system failures to communicate failure status. The interface is the system console port for the Input Computer, and all power-up BIT data and many of the computer subsystem errors or operating system errors are output over this interface. The Input CSCI software, resident in the Input Computer, that communicates via this interface is described in the SRS LMSC-7000835/B100. The Product CSCI software, resident in the Product Computer, that communicates via this interface is described in the SRS LMSC-7000836/C100. The data transferred via this interface are defined in the IRS LMSC-7000833/N200.

3.1.2.1.1.4.3 Input Computer to Product Computer Parallel Disk Subsystem Interface

The Input Computer and the Product Computer will both have access to the parallel disk subsystem and will use it to pass some data between them. The satellite data that is ingested by the Input Computer will be transferred to the disk for storage, and the Product Computer will retrieve the data from the disk as commanded by the user. The disk unit will also be used as a "notepad", that is, there will be an area on the disk that one computer can write informational data and have the other computer retrieve it. Each of the computers has a "host adaptor" board in its VMEbus chassis which controls the interface between the Masscomp computer subsystem and the disk subsystem. The Input CSCI software, resident in the Input Computer, that initializes the board residing in the Input computer, monitors the status of it, and transfers data via it is described in the SRS LMSC-7000835/B100. The Product CSCI software, resident in the Product Computer, that initializes the board residing in the Product computer, monitors the status of it, and transfers data via it is described in the SRS LMSC-7000836/C100. The data transferred via this interface are defined in the IRS LMSC-7000833/N200.

3.1.2.1.1.5 Input Computer to Parallel Disk Subsystem Interfaces

The Input Computer will interface to the Parallel disk drive subsystem via a Host Adapter board resident in the VMEbus of the Input Computer. The Host adapter board is used to transfer the ingested satellite data to the disk array for storage, and use by the product computer. This interface will function as described in the following vendor manuals:

STORAGE CONCEPTS VME/HD/51 Host Adapter User Guide

STORAGE CONCEPTS Differential Fast Bus Interface Manual: Rev 1.0, May 1988

3.1.2.1.1.6 Product Computer to User Station Interfaces

All interfaces from the Product Computer to the User Station will include the transparent transformation into, and back out of, one of several fiber optic links. Since this transformation has no effect on the data input to, or output from the interface, it will not be mentioned in the following paragraphs. The user station can be located up to 10 NM from the processing area (1610). The interfaces between the processing area and the user area is shown in Figure 10. The Product CSCI software, resident in the Product Computer, that communicates via this interface is described in the SRS LMSC-7000836/C100. The Data Archive CSCI software, resident in the Data Archive Computer, that communicates via the serial interfaces is described in the SRS LMSC-7000837/D100. The data transferred via these interfaces are defined in the IRS LMSC-7000833/N200.

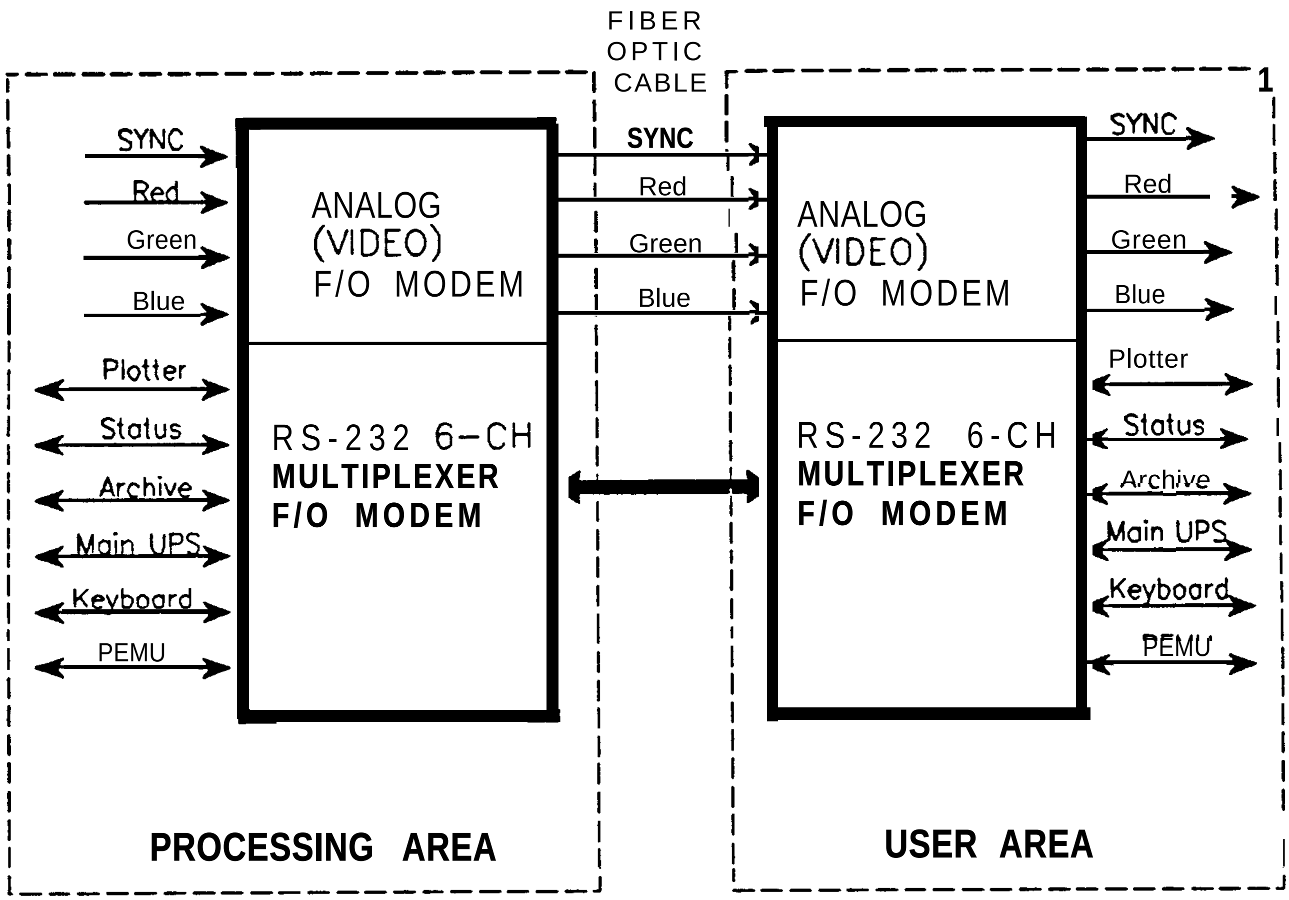


FIGURE 10 – Processing to User Area Fiber Optic Modem Interfaces

3.1.2.1.1.6.1 Product Computer to User Btation Interface - Data Archive

The Product Computer will interface to the Data Archive computer portion of the user station via an RS-232D asynchronous serial link. The baud rate of this interface will be 38.4 Kbaud. The data that the user has commanded to be archived is transmitted via this interface from the product computer to the Data Archive computer at the user station that controls the data archive capability.

3.1.2.1.1.6.2 Product Computer to User Station Interface - Printer

The product computer will interface to the Printer portion of the user station via an RS-232D asynchronous serial link. The baud rate of this link will be 38.4 Kbaud. The images that the user has commanded to be plotted are sent from the product computer to the Data Archive computer that controls the Printer via this interface.

3.1.2.1.1.6.3 Product Computer to User Station Interface - Status

The product computer will interface to the Data Archive computer status portion of the user station via an RS-232D asynchronous serial link. The baud rate of this link will be 9.6 Kbaud. The status of the Data Archive computer that controls the Printer and performs the data archive will be sent to the product computer via this interface.

3.1.2.1.1.6.4 Product Computer to User Station Interface - Video Display Monitor

The product computer will interface to the video display monitor at the user station via three analog video outputs meeting RS-170A signal levels, and an external SYNC line. The three video outputs are the red, green, and blue channels of the video display.

3.1.2.1.1.6.5 Product Computer to User Station Interface - Keyboard and Mouse

The product computer will interface to the keyboard and mouse at the user station via an RS-232C asynchronous serial link. The baud rate of this link will be 9.6 Kbaud.

3.1.2.1.1.7 Product Computer to Operator Station Interfaces

3.1.2.1.1.7.1 Product Computer to Operator Station Interface - Video Monitor

The product computer will interface to the video display monitor at the operator station via three analog outputs meeting RS-170A signal levels and an External SYNC line. The three video outputs are the red, green, and blue channels of the video display.

3.1.2.1.1.7.2 Product Computer to Operator Station Interface - Keyboard and Mouse

The product computer will interface to the keyboard and mouse at the operator station via an RS-232D asynchronous serial link. The baud rate of this link will be 9.6 Kbaud.

3.1.2.1.1.8 Product Computer to Parallel Disk Subsystem Interfaces

The Product Computer will interface to the Parallel disk drive subsystem via a Host Adapter board resident in the VMEbus of the Product Computer, and via two RS-232C asynchronous serial links used for monitoring subsystem status and diagnostics. The Host adapter board is used to transfer the ingested satellite data to the disk array for storage, and use by the product computer. This interface will function as described in the following vendor manuals:

STORAGE CONCEPTS VME/HD/51 Host Adapter User Guide

STORAGE CONCEPTS Differential Fast Bus Interface Manual: Rev 1.0, May 1988

3.1.2.1.1.9 Data Archive Computer to Uninterruptible Power System interfaces

3.1.2.1.1.9.1 Data Archive Computer to Processing Area Uninterruptible Power System Interface

The Data Archive computer will interface to and control the Uninterruptible Power System (UPS) that supplies power to all the MARK IV-B processing area hardware. The interface will be an RS-232D asynchronous serial link operating at 1200 baud. The UPS will be controlled, and will output status and alerts via this interface.

3.1.2.1.1.9.2 Data Archive Computer to User Station Area UPS Interface

The Data Archive computer will interface to and control the UPS that supplies power to all the MARK IV-B user station hardware. The interface will be an RS-232D asynchronous serial link operating at 1200 baud. The UPS shall be controlled, and will output status and alerts via this interface.

3.1.2.1.1.10 Data Archive Computer to Power and Environmental Monitor Unit Interface

The Data Archive computer will interface to and control the Power Control and Environmental Monitor Unit(PEMU), located in the processing area, which controls the distribution of power to all the MARK IV-B processing area hardware. Also the PEMU monitor the environmental sensors which are described in 3.7.2.1.9. The interface will be an RS-232D asynchronous serial link operating at 1200 baud.

3.1.2.1.1.11 PEMU to Environmental Sensor Interfaces

3.1.2.1.1.11.1 PEMU to Processing Area Temperature and **Humidity** Sensor

The interface between the PEMU and the Processing *area* temperature and humidity sensor consists of two 20Ma current loop interfaces, one for temperature and one for humidity. The signal on each can vary from 4 to 20 Ma. The temperature range measured is **from -60°F to 212°F. The relative humidity range is from 0 to 100%.**

3.1.2.1.1.11.2 PEMU to Outdoors Temperature and Humidity Sensor

The interface between the PEMU and the outdoor ambient temperature and humidity sensor consists of two 20Ma current loop interfaces, one for temperature and one for humidity. The signal on each can vary from 4 to 20 Ma. The temperature range measured is from -60°F to 300°F. The relative humidity range is from 0 to 100%.

3.1.2.1.1.11.3 PEMU to Processing Area Barometric Pressure Sensor

The interface between the PEMU and the Barometric pressure sensor is a discrete voltage level output. The voltage level varies from 2.9 to 5.31 volts corresponding to 600mb to 1100mb.

3.1.2.1.2 External Functional Interfaces

The system will receive data from the satellites, process it, and generate products which are to be sent to users via one of several external communications links. The external communications interfaces shall all be located at the processing area, except for the satellite antennas (1050). The system shall be capable of the interface load as follows (1030):

Receive data from:
- Polar Orbiting Satellite
- Geostationary Satellite
- AWN/CFEP Link
- MEDS (When AWN/CFEP is not available)
- HFRB (When AWN/CFEP and MEDS are not available)
- Maintenance interface

Transmit Data to:
- TDA
- Local AWDS
- Maintenance interface
- Maintenance interface

3.1.2.1.2.1 Satellite Data Interfaces

The system shall be capable of receiving RF data transmitted in real time from any one of three geostationary satellites: GMS, GOES-NEXT, or METEOSAT (190)(1880).

The GOES-NEXT data stream is defined in: GOES IJK/LM Operational Ground Equipment (OGE) Interface Specification.

The METEOSAT data stream is defined in: Meteosat System Guide - Volume 9, Meteosat High Resolution Image Dissemination.

The GMS data stream is defined in; Letter; Subject: Information on Planned Changes in the operation of GMS.

The system shall also receive RF data transmitted in real time from the polar orbiting DMSP satellite with either the RTD or RDS data formats: or it shall receive the TIROS data from the NOAA polar orbiting satellite (180)(1880).

The TIROS Data stream is defined in; IS-2285557.

The DMSP RTD and RDS data streams are defined in; IS-YD-812A, and IS-YD-821.

The data from one geostationary satellite and one polar satellite, listed above, shall be received and ingested simultaneously (200). Each of the MARK IV-B systems shall be able to non-simultaneously receive data from two of the three listed geostationary satellites (1150). The data from the one polar and one geostationary satellites shall be received and transferred in parallel to the Input computer (4550).

3.1.2.1.2.2 Local - Automated Weather Distribution System

The Local Automated Weather Distribution System (AWDS) will be a send only net implemented via a Local Area Network, Ethernet (IEEE-802.3), in the MARE IV-B's Product MASSCOMP computer subsystem. Three types of messages are transmitted on this net, Uniform Gridded Data Fields(UGDF), Raster Scan, and Vector Graphic. The format and content for these messages are defined in the OCR-AWDS-01 Interface Design Specification (IDS). The interface will be capable of transferring data at a rate of no less than 1 Mbit/sec.

3.1.2.1.2.3 High Frequency Radio Broadcast

The MARE IV-B shall receive High Frequency Radio Broadcast (HFRB), which is broadcast at a carrier frequency in the range of 2 to 30 Mhz. The broadcast shall use frequency shift keying (FSK). The MARK IV-B will not transmit data via this interface. The data rate for this interface will be 75 bits/sec and the messages use Baudot coding (1510). The alphanumeric data received on this interface shall conform to the World Meteorological Organization (WMO) specification.

3.1.2.1.2.4 Meteorological Environmental Data System

The Meteorological Environmental Data System (MEDS) shall be a receive only net using ASCII coding and a special ASCII protocol. The protocol varies as to the location of the particular MEDS Node. The MARE IV-B decodes only UGDF messages containing 1000 Millibar Height data which are sent in the AWDS Interface Control Drawing format and content, Appendix 30 to the AWDS System Specification.

3.1.2.1.2.5 Satellite Imagery Distribution System

The Satellite Imagery Distribution System (SIDS) shall be a transmit only network which will transmit processed imagery and other digital data as facsimile for SIDS. This interface is specified in the SIDS Interface Specification LMSC 7000839. Maximum allowable transmission time per image shall be 15 minutes. Spatial resolution of the imagery transmitted by SIDS shall be as high as the resolution of stored data available from the MARK IV-B. Imagery transmittal shall contain at least 32 gray shades.

For SIDS transmission of geostationary data, an image is defined as a polar stereographic or Mercator sector, of 1024 X 1024 size, of visible, infrared or water vapor imagery. Geographic location of the sector and type of imagery to be transmitted will be scheduled by the user.

For SIDS transmission, a polar orbiter image is defined as a 2965 km X 5000 km region of visible or infrared imagery in the case of DMSP or one channel (1 through 6) in the case of NOAA. Geographic location of the region and type of imagery to be transmitted will be scheduled by the user.

3.1.2.1.2.6 Tactical Decision Aid

The Tactical Decision Aid (TDA) interface shall provide capabilities to transfer alphanumeric and gridded data in the UGDF Format of Sections 30.4, et. al., in Appendix 30 of System Specification OCR-AWDS-01 between BWOFS and MARK IV-B terminals, via TRI-TAC and non TRI-TAC communication links. The protocol of the TDA interface shall conform to the CCITT X.25 specification. The format and content of the UGDF messages is defined in Appendix 10 to the MARK IV-B System Segment Specification. The requests for the transmission of data will be received on a voice telephone using a verbal request. The TDA data transmission requirements are as follows:

a) Data Rate: Nominal: 32 kbits/second (average)
Minimum: 75 bits/second

b) Average number of transmissions per 24 hours:
1440 individual gridded fields

c) Maximum allowable transmission time: 5 seconds per gridded field

d) Format/Protocol: Per AWDS System Specification

OCR-AWDS-01, Appendix 30, and AWS/DNXP Interface Design Document.

The TDA interface shall include a KG-84A in the signal path to encrypt and decrypt the data stream (740)(760). The KG-84A shall be install in accordance with CSESD-29A and NACSIM 5203 (770). The system shall be designed to handle unclassified data only (730).

3.1.2.1.2.7 Automated Weather Network/Communication Front End Processor

The Automated Weather Network/Communication Front End Processor (AWN/CFEP) will be a multiple net of two separate links both in the United States and overseas. In the United States the full duplex synchronous AWN/CFEP circuits operate at 9600 BPS in the CFEP mode and 4800 BPS in the AWN mode. Overseas the CFEP circuit operates at 4800 BPS and the AWN circuit operates at 2400 BPS. This will be a receive only net for MARX IV-B which decodes only UGDF messages containing 1000 Millibar Height readings. The format and content of the UGDF messages are defined in the OCR-AWDS-01 Interface Design Specification Appendix 30.

3.1.2.1.2.8 Product Computer Maintenance Interface

The product computer will have an interface that may be used by technicians during post-failure diagnosis of the system and for other maintenance functions. The interface shall use a conventional auto-dial telephone line (1330). The interface shall transmit and receive test and maintenance data (1340). This interface shall be an RS-232C asynchronous serial link. The baud rate of this link shall be selectable of 2.4 or 1.2 Kbaud (1350).

3.1.2.1.2.9 Global Positioning System Interface

The System shall receive an external reference time signal from the NAVSTAR Global Positioning System (GPS) (1570). The reference time accuracy shall meet the needs of the system (1580).

3.1.2.1.2.10 Input Power Interface

The System will rely on the local facilities for input power. The local facilities shall transfer adequate power for all systems operations (1590). The input power requirements are described in 3.2.5.12 .

3.1.2.1.2.11 Secure Voice Communications Interface

Secure voice interfaces, connections, power and space shall be provided to interface with either military or commercial telephones (5830).

3.1.2.2 Physical Interfaces

3.1.2.2.1 Internal Physical Interfaces

The System will use equipment that is almost exclusively Commercial Off The Shelf (COTS). The equipment is mounted in standard 19" racks without special mounting requirements. The racks and mounting points within the racks will conform with RS-310.

3.1.2.2.2 External Physical Interfaces

The system will be capable of being installed in the fixed sites as defined by the customer. The details of the interfaces to the facilities is contained in the facilities plan for each of the sites.

3.1.3 Major Component List

<u>Antenna Assemblies</u>

- Pointing Antenna
  - Pointing Antenna Reflector
  - Pointing Radome and Pedestal Assembly
  - Pointing Synchros (Azimuth and Elevation)
  - Pointing Servo Motors (A & E)
  - Pointing Servo Amplifiers (A & E)
  - Pointing Limit Switches (A & E)
  - Pointing Antenna Pedestal Cooling Fans
  - L-Band Low Noise Amplifiers (LNA)
  - L-Band Down Converter (DC)

L-Band Up Converters (UC)
Pedestal Control Unit (PCU) CPU PCB
PCU DAS/DACS PCB
PCU DIG/COM PCB
PCU Synchro Converter PCB
PCU Computer Motherboard
PCU I/O Motherboard
PCU Power Module
PCU Cooling Fans
Fiber Optic Receivers and Transmitters
Fiber Optic Cable

Tracking Antenna

Tracking Antenna Reflector
Tracking Radome and Pedestal Assembly
Tracking Monopulse Converter
Tracking Synchros (A & E)
Tracking Servo Motors (A & E)
Tracking Servo Amplifiers (A & E)
Tracking Limit Switches (A & E)
Tracking Antenna Pedestal Cooling Fans
Tracking Dual Band LNA
L-Band Down Converter
S-Band Down Converter
L-Band Up Converter
S-Band Up Converter
PCU CPU PCB
PCU DAS/DACS PCB
PCU DIG/COM PCB
PCU Synchro Converter PCB
PCU Computer Motherboard PCB
PCU I/O Motherboard PCB
PCU Power Module
PCU Cooling Fans
Fiber Optic Receivers and Transmitters
Fiber Optic Cable

<u>Sheltered (Enclosed) Equipment</u>

Processing Area

Acquisition Equipment

Antenna Control Unit (ACU) (2 ea.)
  Antenna Control Unit (ACU) CPU PCB
  ACU DIG/COM PCB
  ACU Status Monitor PCB
  ACU I/O Interface PCB
  ACU Front Panel Interface PCB
  ACU Display I/O PCB
  ACU Computer Motherboard
  ACU I/O Motherboard
  ACU Power Module
  ACU Front Panel Position MOD Encoder
  ACU Front Panel Switch Matrix
  ACU Cooling Fans
Telemetry Receiver (2 ea.)
Bit Synchronizer (2 ea.)
Frame Synchronizer (2 ea.)
Time Source Equipment
  Global Position System (GPS) Receiver
  Time Code Translator
KG-44 Decyrption Device (2 ea.)
Switch Controller/Matrix
Power Module
Test Group
  RF Power Meter
  Bit Error Rate Tester (BERT)
  PCM Simulator
  Modulator
  IF to IF Converter
Fiber Optic Transmitters and Receivers

Input Computer

Product Computer
  Computer Characteristics
  Chassis
  Expansion Chassis
  Buses
  Power Supply
  Cooling
  Cards
  CPU Cards

Numeric Co-Processor Daughter Board
Memory Cards
Multibus Repeater Cards
High-Resolution Video Card Sets
Enhanced Small Device Interface Controller
IEEE-488 Controller
Asynchronous Serial I/O Controller (RS-232D MUX)
ADCCP Interface Board
IEEE802.3 and X.25 Interface Board
Multibus to Multibus Interface Board
DR11W Interface Board
Parallel Disk Host Adapter Board
VME to SMI bus Interface Adapter Boards
Peripherals
Floppy Disk Drive
Hard Disk Drive (2 ea. per Computer)
Parallel Disk Subsystem
Operator Station
Video Monitor
Keyboard and Mouse
Audible Alarm
Processing Area Uninterruptible Power System
Analog Environmental Sensors
Power Entry Panel
Signal Entry Panel
Environmental Control Unit (ECU)
Processing Area Enclosure
Power Distribution System
User Area
Video Monitor
Keyboard and Mouse (2 ea.)
Color Printers (2 ea.)
Data Archive Computer
RGB to NTSC Video Converter/Encoder
User Area Uninterruptible Power System
Data Archive Tape Unit
Environmental Control Unit

3.1.4 Government-Furnished Property **(GFP)**

The Government furnished property shall include the cryptographic devices, KG-44 and KG-84 (2340) (2350) (2360). The system shall provide all interfaces required to incorporate the GFE equipment (2330).

3.1.5 Government-Loaned Property (GLP)

None.

3.1.6 Government-Furnished Material (GFM)

None.

3.1.7 Government-Furnished Information (GFI)

The government furnished information shall be as specified in the MARK IV-B System Segment Specification (SSS) and the Statement of Work (SOW), and other contract related documents.

3.2 Characteristics

The MARK IV-B system is described, in this section, in terms of performance and physical characteristics. The allocation of specific performance and physical requirements to the components of the prime item is found in 3.7 and sub-paragraphs.

3.2.1 Performance Characteristics

The MARK IV-B will be designed to accomplish, as a minimum, the major/general functional requirements stated below.

The MARK IV-B System will, in general, consist of twelve functional areas. The MARX IV-B shall provide the capability to receive, process, and output products derived from, the polar orbiting, and geostationary satellites for up to 30 hours without any personnel present (15900) (15910).

The system will be of modular design such that it can be selectively adapted by the operating personnel. The system will be expandable and be designed for phased improvements in scientific algorithms and additional environmental parameters.

Brief descriptions of the major functional areas of the MARK IV-B system are listed below;

a) The Data Base Function will be responsible for the storing and retrieval of meteorological information from mass storage. It will automatically handle the maintenance of the data base.

b) The Meteorological Satellite Processing Function generates finished weather products from corrected satellite data. The function converts sensor readings into geophysical and atmospheric parameters, and earth locates said parameters. It will also perform an objective analysis based upon the satellite data. The function will also produce derived fields and displayable weather products from these atmospheric parameters.

c) The Display Function will furnish the users (forecasters) with the capability to manipulate and enhance meteorological data and satellite imagery for its optimum utilization. The function will also provide for adding graphical information to imagery and creating products for further dissemination. The Display Function will produce hardcopy transparencies or paper copies of displayed image or data base imagery merged with graphical data.

d) The External Communication Processing Function will transfer data to/from a number of different tactical systems, and to other users communicating by digital and/or analog output to user communication systems. The external interface handler will also process requests for data from the TDA. The internal interface handler will perform all data conversion and interface the different protocols and data rates. It will be responsible for encryption and decryption for these communication functions in the System.

e) The Antenna Function will track polar orbiting satellites and provide the radio frequency (RF) front end of the System. It will also acquire data from the appropriate geostationary satellites.

f) The Receiver Function will demodulate the RF signals delivered from the antenna function, and prepare such signals for decommutation and other signal processing performed in the Ingest Function. Commandable setting of frequency and demodulation mode will be provided by the Receiver Function.

g) The Ingest Function will decommutate and process data simultaneously from one geostationary meteorological satellite and one polar orbiting meteorological satellite. It will also provide all necessary satellite decryption functions. The Ingest Function delivers processed, corrected satellite data to the Data Base Function.

h) The Antenna Control Function will provide the necessary control and drive signals to position the antenna used to receive data from polar orbiting and geostationary satellites.

i) The System Control Function will provide scheduling for automatic satellite acquisition, performing ephemeris calculations, system checkout, and system status. It will control the internal distribution of data between all other functions. The System Control Function will also provide for remote control of receivers and demodulators.

j) The Environmental Control Function will provide the appropriate environmental condition:; for any hardware that does not meet the external environments of this specification. Detailed environmental requirements are specified elsewhere. Protection from temperature extremes, and electromagnetic pulse will be provided by the Environmental Control Function.

k) The Power Function will supply high-quality electrical power on an uninterruptible, surge-protected basis to the MARK IV-B system. It will also provide other power related facilities, as needed, for proper operation of the system.

1) The Telephone Function will be supplied as Government Furnished Equipment (GFE) to provide secure voice, analog and digital data communications with outside users for unclassified and classified information.

The mission of the MARK IV-B is to provide timely environmental data bases and images from remotely sensed satellite observations to the tactical users and to external systems.

The system shall also provide user/operator stations that will support transactions between operators/users and system controls (6550).

3.2.1.1 Availability

The system shall exhibit an inherent availability (A_i) of not less than 0.9995, as defined below (6110). The MARK IV-B system level Inherent Availability (A_i) is defined in MIL-STD-721C. Inherent Availability is calculated as:

$$A_i = MTBCF/(MTBCF+MTTR).$$

The value for MTBCF to be used in this calculation shall be the System mean time between critical failures. The MTTR shall be the System MTTR. See MIL-HDBK-217E for the calculation of MTBCF.

3.2.1.2 System Effectiveness

The System Effectiveness of the MARK IV-B shall be measured in terms of its capability to be successfully operated to accomplish its mission with the Inherent Availability as specified herein (6120). This is dependent on the correct operation, support, and maintenance of the system.

3.2.1.3 System Warm Start-up

Wherever possible, the equipment within the system shall not require a power-off, power-on cycle to do a warm start (17050). The PEMU will control RESET switches on the two Masscomp computers in the system, and upon command will toggle the switches to perform a restart. Since the majority of the other equipment in the system is COTS, and do not provide the capability to restart without power being cycled, it will have power cycled to perform the warm restart. The system will be operational within 5 minutes after the warm restart is commanded.

3.2.1.4 System Cold Start-up

The system will provide the capability to be powered up from the user station with a single user/operator action. The system will supply the capability to power-up the entire system from the user station. If the operator wants to power up the system from the processing area, he will not have the capability to remotely power-up the user station equipment. The system will be operational within 10 minutes following a cold start-up.

3.2.2 Physical Characteristics

3.2.2.1 Physical Locations

The system will be located at fixed sites as designated by the USAF. The system shall be capable of operation regardless of the latitude or longitude of the site location (7720).

3.2.2.2 Dimensional Limits

The system will be designed to minimize the need for special facility or emplacement requirements. The equipment will be mounted in standard 19" racks, and will require no special mounting. The rack lay-outs for the processing area equipment are shown in Figure 11 and Figure 12.
The system shall:

A) Have overall dimensions for equipment, excluding the user station and antennas and radomes, designed to fit into 160 square feet (5840).

B) Have racks be a maximum of 8 feet tall (5850).

C) Have the user station occupy a maximum volume of 5 feet long by 3 feet wide by eight feet high (5860).

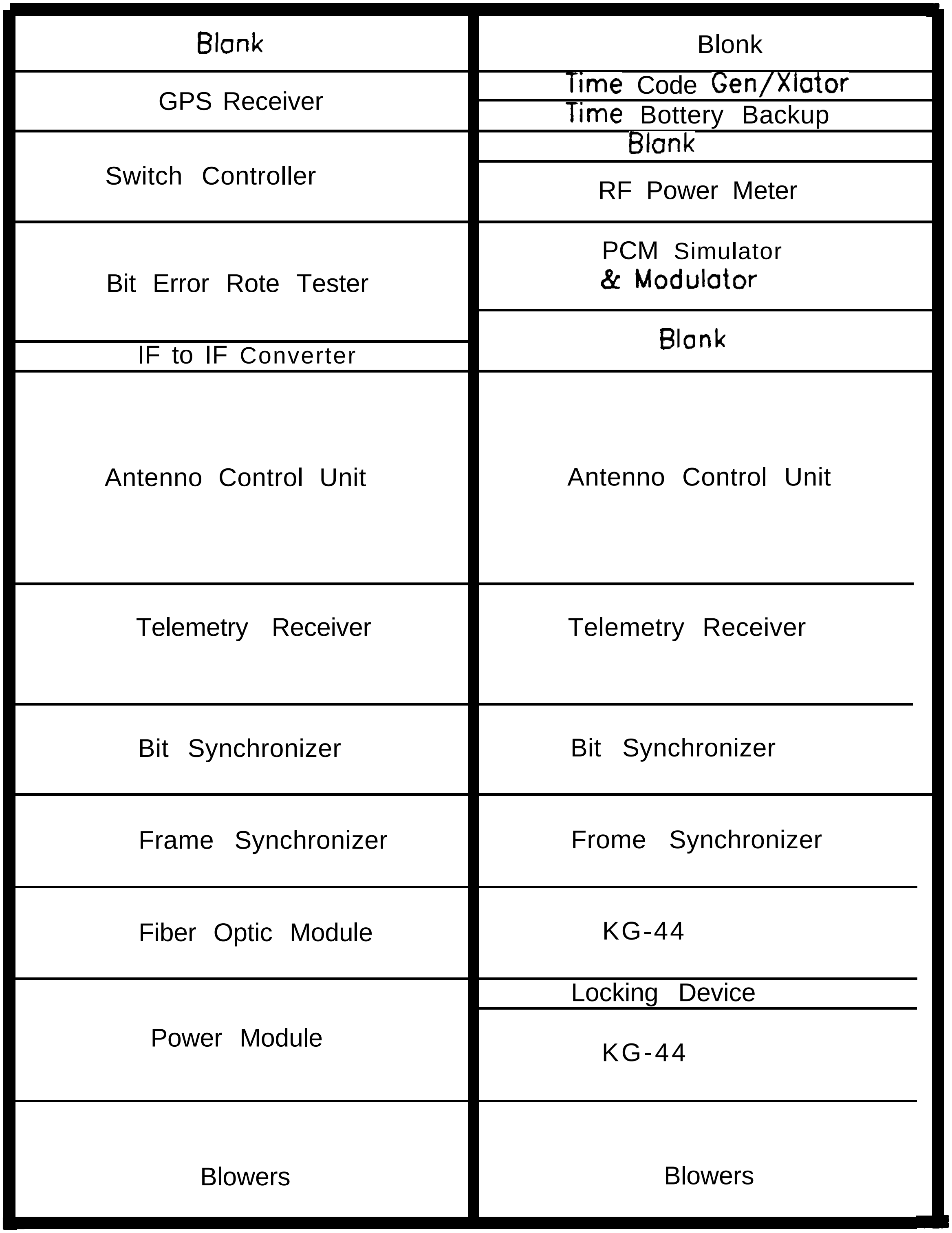


Figure 11 — SDAS Rack Lay-out Diagram

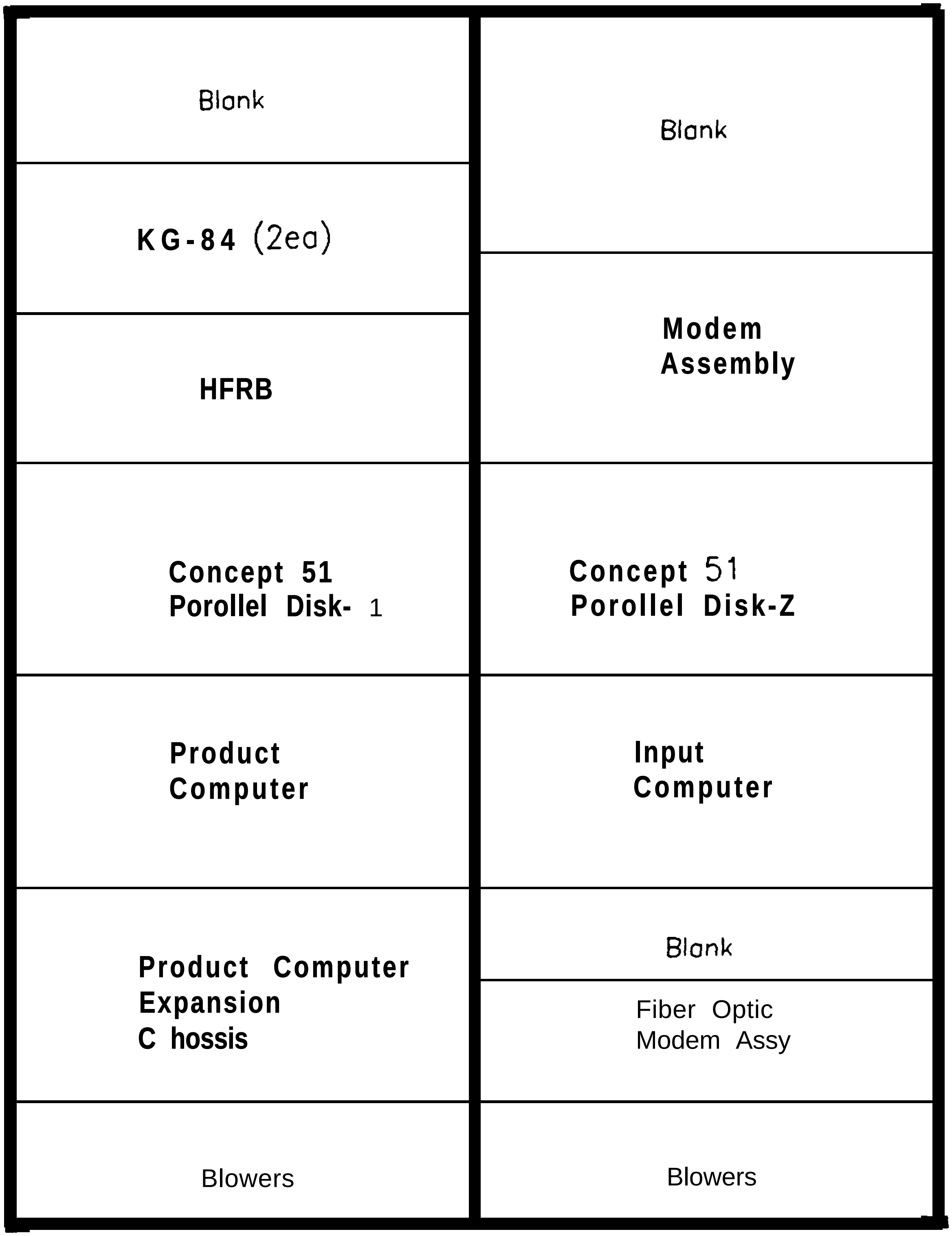


Figure 12 — Equipment Racks 1 and 2
Rack Lay-out Diagram

3.2.2.3 Weight Limits

The system shall have a maximum average floor loading of 200 pounds per square foot (5870). Maximum loading on any single point shall not exceed 500 pounds per square inch (5880).

3.2.2.4 Equipment Ruggedness

The equipment used in the design of the MARK IV-B system falls into two categories, COTS and new deigns. The COTS equipment is high quality commercial or industrial equipment with little or no modification. The ruggedness of the COTS equipment is considered during the selection process for that functional component so that the equipment will meet the requirements of the system. The new designed equipment is designed and built to the appropriate standard and practices as required by this specification, and in meeting these requirements, the equipment is inherently rugged and robust.

3.2.3 Reliability

3.2.3.1 Mean Time Between Critical Failures

The MARK IV-B shall have a mean-time-between-critical-failure (MTBCF) of no less than 2000 hours (5890).

3.2.3.2 LRU Level MTBF Requirements

The MARK IV-B design shall meet the following reliability requirements:

A. All newly designed "box-level" or "board-level" LRUs shall have an MTBF of no less than 5000 hours (5900).

B. All newly designed "box-level" or "board-level" LRUs with less than 8000 hours MTBF shall be backed-up with a redundant unit (5910).

C. All COTS "box-level" LRUs shall have an MTBF of no less than 2000 hours (5920).

D. All COTS "box-level" LRUs with an MTBF of less than 4000 hours shall be backed up with a redundant unit (5930).

3.2.3.3 Failure Definition

A Critical Failure shall be defined as an event or malfunction within the MARE IV-B hardware that contributes to a worse than 50 % increase above the specified time *line to* prepare a product for delivery, failure to service requests from an external user, or causes one or more of the specified output products not to be produced.

The MTBCF at the system level will be calculated with repair as long as the repairs can be done without loss of system capabilities for more than ten minutes (5950).

The MTBF at the LRU level can be calculated or demonstrated without repair (5940).

3.2.4 Maintainability

3.2.4.1 Corrective Maintenance - Organizational Level

3.2.4.1.1 Fraction of Failures Isolated (FFI)

The FFI to a single LRU, using Built-In-Test(BIT), shall be no less than 90 % (5980). The FFI to a single equipment box shall be 99.9 % using BIT, BITE, plus external manual support/test equipment (5990).

The FFI at the depot level to a discardable part or assembly within one hour shall be greater than 50 % (6000).

3.2.4.1.2 Corrective Maintenance Time

The MARE IV-B system shall exhibit a mean-time-to-repair (MTTR) of not more than 60 minutes (6010). The maximum corrective maintenance time (M_{max}) of all repair actions at the 95th percentile, shall be three hours (6020). The number of maintenance personnel required at any time shall not exceed two, as per MIL-STD-721C and MIL-STD-785B. Mean time to repair, as defined herein, is the mean time required to restore failed equipment to operational status and is expressed as:

MTTR = (Summation (lambda$_i$ * Rpi))/
(Summation (lambda$_i$))

where lambda$_i$ is the failure rate of the individual (ith) element of the equipment being measured, expressed in number of failures per million hours, and R_{pi} is the corrective maintenance repair time (hours) of the individual (ith) element of the equipment being measured, including time elements of fault detection, localization, isolation, removal and replacement, alignment, test/checkout (verification of restoration of equipment operability), and reinitializing of all software.

3.2.4.2 Mission Checkout

3.2.4.2.1 Fraction of Failures Detected (FFD)
The FFD shall be greater than 95 % using BIT (5960).

3.2.4.2.2 Mean Time Between Palse Alarms (MTBFA)
The MTBFA shall be greater than 20,000 hours.

3.2.4.3 Maintenance Personnel
The system shall not require more than two maintenance personnel at any time, as per MIL-STD-721C (6030).

3.2.4.4 Mean Time Between Corrective Maintenance Actions (MTBCMA)
The minimum logistics reliability demonstrated as MTBCMA, shall be no less than 720 hours, as described below: (6040) (6050)

MTBCMA is defined as the total equipment operating hours per year minus downtime divided by the number of equipment failures per year.

$$MTBCMA = \frac{\text{(Total equipment operating hours) - (Downtime)}}{\text{Maintenance events*}}$$

* Maintenance events include malfunctions and no defects found.

3.2.4.5 Maintenance Man-Hours per Operating Hour (MMH/OH)
The MMH/OH shall be less than .0233, as described below: (6060)

The MMH/OH formula is defined as total man-hours expended for all maintenance actions divided by the total equipment operating hours. The factor is defined from MTTR times number of failures/year plus PM hours/year divided by the number of hours/year.

$$MMH/OH = \frac{\text{(MTTR X (\# Repairs/Year) + (PM Hours/Year)}}{\text{(Hours/Year)}}$$

3.2.4.6 Preventive Maintenance(PM)
The mean duration of any preventive maintenance action shall not exceed 30 minutes (6070). The total time consumed in a month for preventive maintenance actions shall not exceed 16 hours (6080). No more than one person shall be required to perform any routine maintenance action (6090). If required during PM, mission critical operations shall be restorable within 10 minutes (6100). For purposes of the requirements in this paragraph, MIL-STD-470A shall apply.

3.2.4.7 Built-in-Test (BIT)
Each component of the MARK IV-B system shall provide for the maximum BIT possible. The BIT for each of the components in the system is described in the following paragraphs.

3.2.4.7.1 Computer Built-in-Test
Fault isolation on MASSCOMP equipment is accomplished by means of several levels of hardware and software test

mechanisms. These tools will enable the operator to easily isolate problems to the board/module level for rapid replacement and minimum downtime. Included are the following tools:

a. Hardware light emitting diode (LED) error/status indicators.
b. CPU power-up self-tests.
c. Diagnostic monitor test.
d. UNIX initialization test.
e. UNIX run-time exercises.
f. Run-time error logging and recovery facilities.

3.2.4.7.1.1 Hardware LED Error/Status Indicators

Many boards, controllers and peripherals have LED error and status indicators. These LEDs will assist the operator in identifying basic component malfunctions. Boards, controllers, and peripherals that have LED error and status indicators include:

a. Disk controllers
b. Graphics processors
c. CPUs
d. Multibus
e. Power supplies
f. Auxiliary function module
g. Disk drives (fault indicators)
h. Printers

3.2.4.7.1.2 Power-up Self-tests

After the power is turned on, the power-up self-tests are automatically run by the CPU from EPROM. UNIX is not running: however, a CRT monitor is required for operator communications. If a failure occurs, the machine stops with the failing test number displayed on the console CRT. Included with the power-up tests are:

Test	Component
Cache Data Store Data Integrity	CPU

Cache Data Store Address Integrity	CPU
Cache Byte Write	CPU
Multibus Map Access	Multibus
Multibus Map Data Access	Multibus
Memory CSR Access	Memory
Memory Data Integrity	Memory
Memory Address Integrity	Memory
Graphics Controller Test	Graphics Processor
Floppy Read Test	Floppy Controller

3.2.4.7.1.3 Diagnostic Monitor Tests

The diagnostic monitor is an EPROM resident program. It allows a separate diagnostic program to be loaded from diskette and executed when there is no operating system in memory. When the diagnostic monitor is executed, it will display a special prompt on the console CRT. The operator can request a list of available diagnostic tests to be displayed, or can instruct the CPU to load a specified test. Documentation about running the test is kept on line for easy access. Diagnostic tests are available for:

a. System CPU boards
b. Memory boards
C. Graphics processor boards
d. Data acquisition processor boards
e. Floating point hardware, and so forth

Under diagnostic monitor mode the operator can fault isolate through a series of commands that include, among others, the following:

a. Define unit to test
b. Select unit to test
C. Display control and status state of devices
e. Execute help for diagnostic program
f. Change CPU
g. Enable/disable cache
h. Enable/disable memory management

i. Activate printer port (for hard copy trace)

j. Print various statistical error reports

3.2.4.7.1.4 UNIX Level Exercisers

A variety of nondestructive and destructive programs that run under UNIX can be further used to provide additional fault isolation. Typically, exercisers are used to test peripheral devices such as CRTs, multiplexers, tape devices and controllers, floating point and vector accelerators, disks and controllers, printers, graphics displays, and data acquisition hardware.

3.2.4.7.1.5 UNIX Initialization Tests

When UNIX starts operation, it tests for the presence of all peripheral devices by asserting a Control and Status Register (CSR) operation for every device that has been configured. If the device is present and operational, it will respond to the CSR request and UNIX will enable input/output (I/O) to the device. If the device is not present or does not respond to the CSR request, UNIX will display an error message on the operator console and will inhibit I/O to the device. (This is effectively an automatic controller level test with status display to the console.)

3.2.4.7.1.6 UNIX Run-Time Error Detection/Recovery

Minor errors, such as soft disk errors and tape retries, are displayed on the console message stream. They are also logged onto a disk error file that can be reported at any time.

Major hardware errors (such as stray interrupts) and major operating system errors (such as memory management system failures) will cause an error message to be written into the error log, and the system will "panic trap." When this occurs, an error LED indicator on the console switch will illuminate and the CPU will halt. The operator has the option of making a dump tape of the system image (for later evaluation by the support organization), or immediately attempting to restart.

If a restart is attempted, the system will automatically execute power-up diagnostics, and if passed will attempt to reload UNIX. As part of this procedure, the integrity of the file system will be checked.

If problems are found with the disk data, the system will attempt to rebuild links and recover automatically. If serious data integrity problems are found, the operator will be given the option of terminating and recovery and going into diagnostic monitor.

3.2.5 Environmental Conditions

3.2.5.1 Temperature

3.2.5.1.1 Operating Temperature

The system equipment shall withstand an outside air ambient temperature of $-40^{\circ}F$ to $+131^{\circ}F$ during operation (5460). The system shall operate in this ambient temperature range regardless of the shelter color (5470). The system will be operated within this temperature range only when the equipment in the processing and user areas are in a stabilized environment of $60^{\circ}F$ to $80^{\circ}F$ with relative humidity of 20 to 70%. Any attempt to power up the system with the processing or user areas outside this climate range can cause damage to the equipment.

3.2.5.1.2 Nonoperating Temperature Range

The system equipment shall withstand nonoperating temperature of $-60^{\circ}F$ to $+131^{\circ}F$ (5450). The equipment that is in the user and processing areas during nonoperation will be kept within a nonoperating environment of $+20^{\circ}F$ to $+120^{\circ}F$ with relative humidity of 10 to 80% noncondensing. There will be no thermal shock requirements for this system.

3.2.5.2 Humidity

The system shall withstand an outside relative humidity of 0 to 100 % with condensation, in the -60°F to +131°F range in the nonoperational mode, and in the -40°F to +131°F range during 'operation (5480) (5490). This requirement applies only to the unsheltered equipment in the system (5500). Any unsheltered equipment, or equipment in storage shall meet this requirement (5510). The humidity limits mentioned in the above paragraphs of 20 to 70% operating and 10 to 80% nonoperating shall apply to the sheltered equipment.

3.2.5.3 Salt *Fog*

The system shall be designed to withstand exposure to salt fog as specified in Section II-2.2 of MIL-STD-810D, with a sodium chloride fallout rate as specified in Section 11-3, step 2 of MIL-STD-810D. This requirement is applicable to external environment only, not the equipment within the shelter enclosure (5570).

3.2.5.4 Blowing Dust

The system shall be designed to withstand blowing dust as specified in MIL-STD-810D, Method 510.2, procedure I. This requirement is applicable to external environment only, not the equipment within the shelter enclosure (5580).

Particle sizing conforming to the following:

1) Dust as fine sand (97-99% by weight SiO_2).

2) 100% passes through 100 mesh screen.

3) 98 +/- 2% passes through 140 mesh screen.

4) 90 +/- 2% passes through 200 mesh screen.

5) 75 +/- 2% passes through 325 mesh screen.

3.2.5.5 Fungus

The system shall be designed to withstand fungus as specified in MIL-STD-810D, Method 508.3 . This requirement is applicable to external environment only, not the equipment within the shelter enclosure (5590).

3.2.5.6 Maximum Survivable Wind Speed

All unsheltered equipment shall withstand 140 knot wind, in a nonoperational mode. This is with the antennas in the stowed position.

3.2.5.7 Operational Wind Speed Combined with Rain

The unsheltered equipment shall withstand 56 knot winds with rain at 10 cm/hour, in accordance with MIL-STD-810D(T), method 506.2 (5540).

3.2.5.8 Performance under Icing Conditions

The unsheltered equipment shall operate with up to 13 millimeters of ice accumulation, in accordance with MIL-STD-810D(T) , Method 521.0 (5550). The system shall operate at 0.6 of the maximum survivable wind speed with this ice loading in a nonoperational mode (5530).

3.2.5.9 Other Climatic Conditions

The conditions specified in MIL-STD-210C, except for the paragraph entitled "Extremes for Naval Surface and Air Environment" shall be met by sheltered systems with the conditions outside the shelter, all unsheltered equipment, and all non-operating equipment. Any conditions that are stated in this document take precedent (5560).

3.2.5.10 Chemical and Biological Contamination

The system shall be designed to allow operation and maintenance by personnel wearing Nuclear/Biological/Chemical (NBC) protective clothing in an NBC contaminated environment, as specified in MIL-STD-1472C (5600) (17530) (17540). All common and peculiar test equipment shall be usable by operators wearing NBC protective clothing (17550. All special tools shall be usable by operators wearing NBC protective clothing (17560). The viewing of the user and operator displays shall be compatible with personnel wearing an NBC mask. The user shall maintain full operational capability while wearing protective clothing (6560). The user station equipment shall be comfortable to operate and shall provide fast and easy access to display and control while the user is wearing NBC protective clothing (12270).

3.2.5.11 Electromagnetic Compatibility and Electromagnetic Interference. (EMC/EMI)

The system shall be designed and tested in accordance with MIL-STD-461C, and MIL-STD-462, as class Alh equipment and with MIL-E-6051D (5620) (5630). The system shall be designed and constructed to minimize EMI propagation from the system to outside the shelter (5640). The system shall be designed to minimize susceptibility to interference from sources outside the system (5650). The equipment within the MARK IV-B shall operate without degradation with other equipment operating nearby (5660). The system shall not be affected by or affect other equipment from voltages or EMI fields (5670) (5680). The system shall be designed to resist EMI as specified in MIL-STD-461C, part 3, for equipment category A 2d (class A3 ground based equipment procured for Air Force use) (720).

3.2.5.12 Input Power

The system shall operate with three phase local power of 120/208 volts +/-10% at 50/60 Hz +/-5% (5690) (5700) (5710). The voltage waveform deviation factor shall not exceed 10%, and the maximum transient (for a period of less than 5 milliseconds) voltage amplitude shall not exceed 30% of the nominal voltage levels (5720) (5730). All equipment within the MARK IV-B system shall operate without degradation under these power conditions (5740).

3.2.5.12.1 Short Term Input Power Loss

The system shall be fully operational in no more than 10 minutes after restoration of power following a power loss of one hour or less (5810).

3.2.5.12.2 Long Term Input Power Loss

The system shall be fully operational in no more than one hour after restoration of power following a power loss of longer than one hour (5820).

3.2.6 Transportability

The system design, engineering and construction shall be guided by AFR 80-18 (6130). All equipment shall be air or surface transportable in accordance with MIL-P-9024G (6140). All equipment in its proposed shipping configuration that will be unsuitable for normal transportation methods shall be identified (6150).

3.2.7 Portability

The MARK IV-B system is intended for fixed site installations, and shall have no requirements for portability beyond the ability to remove and replace equipment for maintenance and repair (6160).

3.3 Design and Construction

The design and construction of the system shall maximize the use of Mil/Fed specification parts that are currently in the active system (6170). The design shall also maximize modularity (6180).

3.3.1 Materials, Processes, and Parts

The system shall use Commercial Off The Shelf (COTS) equipment where ever possible (6190). Any newly designed equipment shall be designed and manufactured in accordance with MIL-E-4158E (6200).

3.3.1.1 Moisture and Fungus Resistance

The materials used in the construction of the MARK IV-B system shall comply with the moisture requirements of MIL-E-41583, para 3.2.25; and the fungus inert materials requirements as specified in Requirement 4 of MIL-STD-454K (6210) (6220).

3.3.1.2 Corrosion Resistance and Control

All materials shall be properly treated in accordance with MIL-E-4158E, para 3.5.3; and MIL-STD-454K, Requirement 15 (6230).

3.3.1.3 Grounding

The system shall be bonded and grounded in accordance with MIL-STD-188-124A and MIL-HDBK-419 (6240). In each chassis, technical, power, and chassis ground shall be isolated and shall be brought out and connected to a single earth ground (6250) (6260). Because of the use of COTS equipment, the above requirements shall be met on all newly designed equipment and at the rack or system level, but may not be met at the box or LRU level.

3.3.1.3.1 Ground Potential

The system design shall ensure that all enclosures and racks are always at earth potential (6270). Any convenience outlets shall ensure the grounding of any connected device (6280).

3.3.1.3.2 Corona and Electrical Breakdown Protection

Corona and electrical breakdown prevention shall conform to requirement 45 of MIL-STD-454K (6290).

3.3.1.3.3 Electrostatic Discharge control

The system shall be designed to prevent damage to the system equipment from Electrostatic Discharge (ESD). The handling and packaging of the system equipment during development and test will comply with LMSC MPS-4030.

3.3.1.4 Equipment Interconnection

Newly designed equipment shall be interconnected with cables terminating in keyed connectors (6300). Newly designed multipin cables shall have at least 25 % spare pin margin (6310).

3.3.1.5 Minimization of Moving Parts

The system design shall minimize the use of moving parts when there is a cost-effective, equivalent option (6360).

3.3.1.6 Switching Device Life

Power supply circuit breakers and relays, and telephone line switching devices shall have a minimum specified life of 100,000 operations (6380). All other switching devices shall have a minimum specified life of 5,000,000 operations (6370).

3.3.1.7 Interchangeability, Modular Construction

The system shall be designed in a modular fashion to allow the easy plug-in replacement or interchange of components. The modularity of the system shall be based on logical functional concepts (6400).

3.3.1.8 LRU Level

The system shall be designed such that the LRUs are at the Printed Circuit board, or module (6410).

3.3.1.9 Microprocessor Standardization

The system shall be designed such that the use of a common family of microprocessors is maximized. As a goal, the microprocessors shall be from the same design series, product series, and be interchangeable (6420) (6430) (6440).

3.3.1.10 Redundant Equipment

The system design shall allow for the reconfiguration of redundant equipment that is at least 500 feet from the operator/user areas (6450).

3.3.1.11 Nonredundant Operation

The system design shall allow for normal operation with redundant components removed (6460).

3.3.2 Electromagnetic Interference (EMI) Control

The system design for electromagnetic interference control, compatibility, spike susceptibility, and electronic countermeasures vulnerability shall be in accordance with MIL-E-4158E as they apply to measurements outside a 50 foot radius from the equipment (6320).

3.3.2.1 High-altitude Electromagnetic Pulse

The system shall be designed to operate without degradation from High-altitude Electromagnetic Pulse (HEMP) arising from exoatmospheric nuclear events. The system will be designed to withstand HEMP effects while installed with all cabling and grounding installed. During storage and transportation the system will not withstand HEMP effects because of the lack of shielding integrity and proper grounding. The waveform of the voltage field (E field) and the magnetic field (H field) is given by the equation:

E(t) = 5 x 104 (e -2.56 x 106t - e-460 x 106t) volts/meter

H(t) = 132.6 (e -2.56 x 106t - e-460 x 106t) ampere turns/meter

where t is in seconds.

The peak values of electro magnetic pulse shall be survived:

E(peak) = 50K volts/meter

H(peak) = 132.6 ampere turns/meter

DNA Handbooks 2114 H-l, -2 and -3 shall be used as guidance for HEMP protection design. (1000) (1002) (1004) (1006)

3.3.3 Name Plates and Product Markings

The system design shall meet MIL-E-4158E for the nomenclature, identification marking and labels (6330). The requirements for the size of the lettering and the location to label borders shall not be met. The marking for shipping and storage shall be per MIL-STD-129J (6340). The equipment will be identified per MIL-STD-130F.

3.3.4 Workmanship

Workmanship for the non-COTS equipment shall be in accordance with Requirement 9 of MIL-STD-454K (6350).

3.3.5 Interchangeability

The MARK IV-B system shall be designed to maximize the use of simple plug-in components, and minimize the need for calibration and/or adjustment after the replacement of a LRU. The COTS components of identical part numbers shall be interchangeable. The newly designed equipment will be designed such that all LRUs are replaceable/interchangeable with identical units, without complex adjustments or calibration.

3.3.6 Safety

The design of the system shall provide maximum protection against personal injury and equipment damage (6470). System safety principles and practices shall be applied throughout the duration of the project in accordance with MIL-E-4158E, paragraph entitled "Safety of Personnel" (6480).

3.3.6.1 Safety Criteria

The design of the system shall apply safety criteria to eliminate or minimize all hazards that may cause injury (6490). Hazards such as sharp edges, projections, and/or moving parts shall be minimized (6500).

3.3.6.2 Electrical Overload Protection

The system design shall provide electrical overload protection conforming to requirements 8 and 27 of MIL-STD-454K for circuit beakers (6510).

3.3.6.3 Fuses, Fuse Holders, and Associated Hardware

The system design shall incorporate fuses, fuse holders, and associated hardware that conform to MIL-STD-454K requirement 39 (6520).

3.3.6.4 Lightning Protection

The system design shall provide for protection for lightning strikes per MIL-STD-454K requirements 1 and 74 (6530).

3.3.7 Human Performance and Human Engineering

The system shall meet the human engineering specifications of paragraphs 5.1-5.9, 5.12.7, 5.12.8, 5.13 and 5.15 of MIL-STD-1472C (6540). The design of the system shall use the remainder of the document as a guideline. The COTS equipment shall be selected with the Human Engineering factors being considered: however, the COTS equipment shall not be modified to meet the specifications. The system shall be operable by right or left handed personnel (6570) (12290). The user shall be able to operate the system in comfort, within all specified dimensional constraints (6580).

3.3.7.1 Visual Considerations

The design of the displays shall be in accordance with the applicable sections of MIL-STD-1472C mentioned above. The displays shall be easily read with ambient illumination of up to 30 lumens per square foot (Approx 30 foot-candles) (6600). The user displays shall be designed with visual considerations of legibility, size, shape, spacing, brightness, color, contrast, and blink rate (6590).

3.3.7.2 Aural Considerations

The aural indicators and alarms are to be designed in accordance with the applicable. sections of MIL-STD-1472C that are listed above (6630). The design of the indicators and alarms shall consider the tone, pitch, and intensity-of the item (6610). A capability for resetting the signals after they occur shall be provided; however, the reset shall not affect subsequent signals from being generated (6650)

(6660). The intensity control of the alarms and indicators shall be in accordance with MIL-STD-1472C (6640). Both intensity control and reset shall be accessible from outside of the unit (6670).

3.3.7.3 Noise Levels

The equipment acoustical noise levels shall meet MIL-STD-1472C (6620). The system shall be designed such that the user station area noise level shall not exceed NC-50 (6680). The noise level in all other locations within the system shall not exceed NC-70 (6690).

3.3.8 Embedded Computer Resources

3.3.8.1 Operational Computer Hardware

The system shall be designed to meet the general requirements listed in this paragraph.

A) System architecture shall promote modularity, expandability, and flexibility by utilizing standard elements (6710). Reliability, maintenance replacement at the board level, and low cost upgrades are prime considerations. This shall be achieved by employing widely supported open architecture backplanes, and avoiding wherever possible the use of unique or specially designed, custom interfaces (6720) (6730).

B) Hardware components shall be testable in the system configuration (6740).

C) Wherever possible, data communications shall use industry standard interfaces (6750).

3.3.8.2 Processors Throughput Margin

Each processor shall have at least 50 % greater throughput than is required to meet all functional and performance requirements stated in the SSS, as estimated at CDR (6760). The throughput reserve shall be in addition to that needed to fulfill any single requirement or combination of requirements that could be jointly loaded into the processor(s) (6770).

3.3.8.3 Computer Memory and Mass Storage

3.3.8.3.1 Primary Memory
The system computers shall be designed with 50% memory reserve. This reserve is memory beyond the amount of memory required to perform all possible processing of the system (6780). The system shall have a 250% growth capability without introducing additional hardware or electrical changes (6790) (6800). The growth capability of the primary memory will be done by replacing the existing low density RAM boards with higher density boards.

3.3.8.3.2 Mass Memory Storage Capacity
The system shall have 50% mass storage reserve. The system shall have 100% mass storage growth capability (6820). To meet the growth capability requirement, the mass storage subsystem will be able to have added tiers of disc drives added to the subsystem to increase the capacity of the subsystem.

3.3.8.3.3 Computer Bus Requirements
The system shall employ widely used or industry standard bus architectures (6830). The data *errors* added by the buses shall not exceed 10^{-12} errors/sec (6840).

3.3.8.3.4 Input/Output (I/O)

3.3.8.3.4.1 Input/Output (I/O) Data Rates
The system design shall permit, the I/O of required data without any adverse effects on other processing (6850).

3.3.8.3.4.2 I/O Expansion and Growth Margins
A) Each *processor* shall have a I/O reserve of 25%, and growth capability of 50% (6860) (6870).

B) All newly designed I/O circuitry shall be designed with line receivers having a minimum of 80db common mode noise rejection ratio (CMRR) (6880). The overshoot and undershoot of the waveform at all nodes of the I/O bus shall not exceed 10% of the total amplitude (6890).

3.3.8.3.4.3 Direct Memory Access (DMA)

The architecture of DMA devices in the system shall minimize the intervention or interference with the processors (6900). Any newly designed DMA devices shall have line driver/receiver pairs of no less than 80 Db CMRR (6910). All DMA interfaces shall be designed such that power-up or power-down transients do not cause erroneous operation or data transfer (6920).

3.3.8.3.5 Hardware Data Transfer Time

The computer design shall ensure that the worst case timing of data transfer delays caused by the hardware will not exceed 75% of the available cycle time (6930). This is to be met at worst case temperature and chemical environments.

3.3.8.3.6 Computer Memory Redundancy Effectiveness

All memory in the system shall be EDAC, with single bit correction and double bit detection capability (6940) (6950). The memory shall be able to detect, isolate, or correct 98% of transient memory faults (6960).

3.3.8.4 Computer Software

The system software requirements are detailed in the MARK IV-B Software Requirements Specifications (SRSs), as assigned by the Requirements Traceability Matrix (RTM), and related documents including the Interface Requirements Specification (IRS), and. System/Segment Design Document (SSDD).

3.4 Documentation

The documents listed in these paragraphs are to be delivered as part of the MARK IV-B system.

3.4.1 Specifications

System Engineering Management Plan **(094A2)**
System Security Management Plan **(139A2)**
System/Segment Design Document **(133A2)**
Human Engineering Program Plan **(035A2)**
Software Development Plan **(070A2)**
Software Quality Program Plan **(136A2)**
Software Requirements Specifications **(068A2)**
Software Design Document **(059A2)**
Firmware Support Manual **(066A2)**
Software Product Specifications **(069A2)**
Interface Requirements Specification **(140A2)**
Interface Design Document **(141A2)**
Environmental Management Plan **(122A2)**
System Configuration Management Plan **(015A2)**
Quality Program Plan **(088A2)**
Computer Resources Integrated Support Document **(067A2)**
EM1 Control Plan **(080A2)**
Human Engineering Design Approach **(036A2)**
Interface Control Document **(024A2)**
Interface Specification **(025A2)**
Manufacturing Plan **(075A2)**

3.4.1.1 **Systems** Effectiveness Documents

Parts Control Program Plan **(021A2)**
Program Parts Selection List **(074A2)**
Systems Safety Program Plan **(096A2)**
Safety Assessment Report **(098A2)**
Maintainability Prediction Report **(086A2)**
Maintainability Analysis Report (087192)
Reliability Program Plan **(081A2)**
Reliability Prediction Report **(082A2)**
Preliminary Hazard **Analysis(097A2)**
Failure, Mode, Effects, and Criticality Analysis Report **(084A2)**

3.4.2 Test Plans and Procedures

Test Requirements Document **(008A2)**
Final Test Report **(106A2)**

Software Test Plan (060A2)

Software Test Report (062A2)

Software Test Descriptions (061A2)

System Test Plan (099A2)

Installation Test Plan/Procedures (103A2)

EM1 Test Plan (028192)

EM1 Test Report (027A2)

Human Engineering Test Plan (036A2)

Human Engineering Test Report (039A2)

Contractor Test Plan/Procedure (100A2)

Reliability Test Plan (090A2)

Reliability Test Report (091A2)

Environmental Stress Screening Report (089A2)

Maintainability Program and demonstration Plans (085A2)

3.4.3 Drawings

The majority of the equipment used in the MARK IV-B system is Commercial Off The Shelf (COTS) hardware. This COTS equipment is supported by existing vendor drawings. The LMSC generated drawings are as shown on the MARK IV-B Drawing Tree LMSC 7035926. The existing vendor drawings are to be left un-modified in vendor format. The LMSC drawing package shall be in accordance with DOD-D-1000B and DOD-STD-100C.

3.4.4 Technical Manuals

Technical Manual Publication Plan (109A2)

Technical Manual Validation Plan (113A2)

Computer System Operator Manual (063A2)

Operation Instruction Manual (130A2)

Maintenance Instruction Manual (130A2)

Preventive Maintenance, Workcard Set (130A2)

Software Programmers Manual (134A2)

Software Users Manual (064A2)

3.4.5 Logistics Documentation

Logistics Support Analysis Record (046A2)

Illustrated Parts Breakdown (130A2)

List of Applicable Publications (130A2)

Work Unit Code Manual - Supplement to 31M1-4-48-06 (130A2)
Preservation and Packaging Data (076A2)
Special Packaging Instructions (077A2)

3.5 Logistics

3.5.1 Integrated Logistics

The design of the MARK IV-B system shall have supportability as a major design factor (7680). Integrated Logistics Support (ILS) shall be accomplished by performing Logistics Support Analysis (LSA) concurrent with the design of the system (7690). ILS shall meet the inherent availability and maintainability requirements (7700).

3.5.1.1 Readiness and Deployment

The system shall be capable of being deployed anywhere in the world, at any altitude up to 10,000 feet altitude (7720) (7710) (5440).

3.5.1.2 Maintenance Concept

The system maintenance concept shall include (7730):
A) Organizational Level
B) Depot Level

Automatic, Built-in Test Equipment (BITE) will be inherent in the equipment design. BITE shall be capable of isolating faults to the LRU level, and shall be present through-out the system (7740). The capability to switch the equipment as required for automatic testing shall be provided (17410). The equipment in the MARE IV-B shall provide access to the test points to be tested by the system control function (17500). The System Control Function shall support the maintenance of the system (17480). For those faults that are not compatible with BITE, common support equipment shall be used to test (7750).

Maintenance requirements shall be determined by using LSA and Repair Level Analysis (RLA), as defined in MIL-STD-1388-1A(T) and MIL-STD-1388-2A(T) (7760).

3.5.1.2.1 Organizational Level Maintenance
The organizational level maintenance shall have the following conditions (7770) (7780) (7790) (7800):
A) Fault isolation to the LRU.
B) Removal and replacement of the LRU.
C) Alignment (as required).
D) Re-test and verification of operation.

3.5.1.2.2 Depot Level Maintenance
All LRUs in the system that are not repairable at the organizational level shall be repairable at the depot level, or replaceable if not repairable (7820). All maintenance tasks that require a high degree of specialization shall be done at the depot level (7810).

3.5.1.2.3 Simplicity of Repair
The LRUs in the system shall not require any cutting, desoldering, soldering, or other actions beyond a simple plug-in replacement. All LRUs shall be easily removed and installed. The maintenance at the organization level shall be limited to the removal and replacement of LRUs (7830). The replacement of any LRU in the system shall not require the realignment of equipment (7840). The test points and alignment controls shall be placed for easy access by the operator (7850).

3.5.1.2.4 Remote Maintenance Capability
The system shall provide a remote maintenance interface that is accessible via a standard telephone line at the organizational level (7880). This interface shall allow personnel at another location to electronically trouble-shoot the system (7860). The system shall be designed to maximize the remote diagnostic and maintenance capability (7870). An auto-dial modem with transmission speed no less than 1200 baud, and the required telephone equipment, shall be provided in the system. The modem and telephone equipment will be compatible with the host nation telephone

systems. The interface shall allow the transmission of digital data to and from the computer.

3.5.1.2.5 Maintenance Support Equipment
The system shall be design such that the BIT and BITE minimize the need for support and test equipment. The system design shall provide for the minimization of the duration and frequency of preventive and corrective actions.

3.5.1.2.6 Common Support Equipment
All common support equipment that is required for organizational and depot level maintenance shall be provided to support the contractor maintenance periods (7920). The deliverable common support equipment will be provided upon direction and funding by the Air Force upon approval of the SERD's. The communications link with the equipment shall be an industry standard link and shall be of adequate bandwidth to not impede data transmission (18150) (18160). The common support equipment shall include all required equipment for manual maintenance procedures (17490). Common support equipment shall include "COTS test equipment (7910). The selection of *common* support equipment shall be restricted to the items that are listed in MIL-HDBK-300 to the maximum extent feasible (7930).

3.5.1.2.7 Peculiar Gupport Equipment
Any peculiar support equipment required by the system for depot and organizational level maintenance shall be provided to support the contractor maintenance periods. The deliverable common support equipment will be provided upon direction and funding by the Air Force upon approval of the SERD's. The communications link with the equipment shall be an industry standard link and shall be of adequate bandwidth to not impede data transmission (18150) (18160). All test equipment that is not common support equipment is peculiar support equipment (7940).

3.5.1.2.8 Facilities and Facility Equipment

All facility related equipment that are required to maintain the system in operational mode shall be provided. The facilities shall provide protection from the climatic extremes for the sheltered equipment.

3.5.2 Supply Support

The system design shall minimize problems inherent in keeping an inventory of unique parts. The system shall use parts that are commonly available in the DoD supply system. To minimize the impact on Air Force Depot Supply support, use of the same plug-in board/subchassis in more than one application within the system shall be maximized. Other considerations shall include:

A) Spares, repair parts and special supplies required to satisfy all MARX IV-B maintenance functions shall be provided by the contractor during the contractor maintenance period of performance (7970).

B) Spares, repair parts acquisition, control storage, shipments to site, inventory control procedures, planned use of government stock listed items, and maintenance stock levels shall be established in accordance with government direction received during the provisioning process (7980).

3.6 Personnel and Training

3.6.1 Personnel

3.6.1.1 8kill Level -Users

The system user shall have the skill level and qualifications of an experienced forecaster knowledgeable in satellite data interpretation. The user shall be weather personnel with AFSC 2524 as specified in AFR 36-l page A10-7, or shall be 5-Level enlisted forecaster, AFSC 251X0, as specified in AFR 39-l pages A12-1 through A12-8 (8020).

3.6.1.2 skill Level - Maintainers/Operators

The system shall be designed to be operated and maintained by maintainers/operators who are experienced personnel , AFSC 309X0 as specified in AFR 39-1 pages A5-77 through A15-88, skill level 5 (8030).

3.6.2 Training Concepts

The training concept utilized for the MARK IV-B will be initial contractor Type I Training for Users and Maintainer/Operators. All follow-on initial training for Maintainer/Operators and METSAT Coordinators will be developed by Headquarters Air Training Command (HQ-ATC). ATC instructors will attend the Type I courses and use the materials developed by the contractor to develop the ATC courses. ATC training will be conducted on either simulators or operational equipment. Other operational training not provided by ATC will be provided at the operational units by On the Job Training (OJT). OJT will be conducted with hands-on teaching and programmed learning modules.

3.6.2.1 Training

Specialized contractor training shall enable users and maintainer/operators to perform system operational and maintenance tasks on the MARK IV-B system commensurate with their experience as specified above in AFR 39-1 and AFR 36-1.

3.6.2.1.1 Training - Users (3330 TCHTG, Chanute AFB, IL.)

Specialized Type I training shall provide ATC instructors and initial cadre METSAT Coordinators with the theory, background knowledge, and skills to successfully operate the system and to fully utilize the specialized functions necessary to generate and analyze weather products, and instruct other system users how to perform the same functions on the MARK IV-B system.

3.6.2.1.2 Training - Maintainers/Operators (3430 TCHTG, Lowry AFB, CO)

Specialized Type I training shall provide ATC instructors and initial cadre Maintainers/Operators and depot maintenance personnel (USAF/AFSC 309X0, USMC/MOS 5938) with the theory, background knowledge, and skills to perform organizational level maintenance, and instruct other system maintainer/operators how to perform the same functions on .the MARK IV-B system.

3.7 Major Component Characteristics

The characteristics of the major components of the MARE IV-B system are detailed in the following paragraphs.

3.7.1 Antenna Assemblies

The characteristics of the Major Components that make up the Antenna Assemblies are described in the following paragraphs. The Polar and Geostationary antenna assemblies comprise the front end of the system: each RF data stream is down converted and retransmitted via fiber optic link to the acquisition and processing area, for simultaneous reception and processing of Polar and Geostationary satellite data. (450). The antennas shall be capable of pointing and/or tracking from horizon to horizon at all azimuth and elevation angles (15630) (4600) (4590). Each fixed site antenna shall have antenna status and pointing data transferred to system control (15600). The Antenna shall receive automatic positioning control signals from the Antenna Control Function and shall provide the operator with antenna position control and status at the operators station (15620). The antennas shall provide the capability to receive and transfer data simultaneously to the respective Telemetry Receivers (4540). The antenna assemblies shall provide adequate gain to achieve a maximum bit error rate of 10^{-6} for the polar orbiting satellites at 20^{o} above the horizon (1065) (1130) (4730). At 20^{o} elevation the link margin for the polar orbiting satellites shall be no less than 6db for the DMSP and 4db for the NOAA polar orbiting satellite (1085) (1125). The bit error rate for the GOES I-M shall be 10^{-5} maximum, and 10^{-6} for the other geostationary satellites (1190) (1200) (4740). The link margin for the geostationary satellite shall be no less than 2db at 20° elevation (1180). The link margins and bit error rates are computed including all losses from the radomes and local transmission losses (4570). The pointing antenna and components of the system required to receive the geostationary satellite data shall be able to re-position/reconfigure to receive a different satellite transmission within 5 minutes after the end of a transmission (1160) (4620) (15640). The tracking antenna shall permit the repositioning of the dish from horizon to horizon and begin acquisition of another polar satellite pass (4820). The fixed site installations shall have a radome enclosing the antenna reflector and associated electronic equipment, while the mobile sites shall not have a radome (4560) (4630).

3.7.1.1 Pointing Antenna

The Pointing Antenna will provide the system the capability to receive data from geostationary satellites. The characteristics of the components of the Pointing Antenna are described in the paragraphs below. The pointing antenna shall point to within 1° of the commanded position of the geostationary satellite (4610).

3.7.1.1.1 Pointing Antenna Reflector

The Antenna Reflector will be a 17-foot diameter parabolic reflector with the RF pick-up at the focus. The reflector will be constructed so that it is assembled/disassembled in radial slices. There will be a test probe mounted on the antenna reflector that will allow the insertion of test data signals into the acquisition system. The specific characteristics are described in the following subparagraphs.

3.7.1.1.1.1 Performance Characteristics

The 17-foot pointing antenna will provide:

a. 37.1 dB of gain between 1680-1720 MHz, with an output VSWR of 1.5:1 maximum.

b. Rotatable (360°) variation linear polarization.

c. 2.3° nominal 3dB beamwidth, with the peak sidelobes 20dB below main lobe response.

d. A test probe for system testing.

3.7.1.1.1.2 Physical Characteristics

The 17-foot antenna will conform to the following physical characteristics:

a. Diameter will be 17 feet.

b. Weight will be 900 lb maximum.

c. Surface tolerance will be 0.030 inch maximum.

d. First natural resonant frequency will be $\geq$ 15Hz.

e. Reflector will be a minimum of 12 assembled sections.

3.7.1.1.2 Pointing Radome and Pedestal Assembly

In the fixed site installations, the Radome will be used to enclose the antenna reflector and the electronic equipment that comprise the antenna assembly. The interior of the Radome shall be environmentally controlled (4640). The Pedestal assembly will be the mounting structure for the entire antenna assembly. It will be secured to mounting pads, supplied by the facility, and will be capable of supporting the antenna assembly in the required climatic extremes.

3.7.1.1.2.1 Performance Characteristics

The 17-foot pedestal will provide azimuth and elevation rotation per the following requirements:

	AZIMUTH	ELEVATION

	GEAR RATIO 2776:1	TURN RATIO 24,347:1
CONTINUOUS DRIVE TORQUE	6450 ft-lb	20,500 ft-lb
PEAK DRIVE TORQUE (Intermittent Duty)	6450 ft-lb	20,500 ft-lb
RATED GEAR STRENGTH	7000 ft-lb	70000 ft-lb
ANGULARTRAVEL	+/- 1804	60 DEG TOTAL, (WITHIN 0½ TO 90½)
MAXIMUM VELOCITY	1½/SEC	1½/SEC
COMPLIANCE	1 X 10^{-6}RAD/FT-LB	1 x 10^{-6} RAD/FT-LB
DATA PACKAGE	1X SYNCHRO	1X SYNCHRO
BACKLASH	0.04	0.04

3.7.1.1.2.2 Physical Characteristics
The 17-foot pedestal will conform to the following physical characteristics (weight and size). The pedestal will be portable and designed for assembly/disassembly by two men. Pedestal will make maximum use of captive hardware.

a) The total weight of the Pointing Antenna Pedestal will be no greater than 1800 lb.

b) The size of the Pointing Antenna Pedestal will be such that the entire range of pointing angles as defined in 3.7.1.1.2.1 can be met.

3.7.1.1.3 Pointing Antenna Synchros (Azimuth and Elevation)

3.7.1.1.3.1 Performance Characteristics
Both Synchros, Azimuth and Elevation (A & E) will provide:

a. Three-phase signal of 90Vrms, 60Hz signifying motor angular position to within 6 minutes (0.1 degrees).

b. Null voltage for zero degrees will be 60mV maximum.

c. Input power will be 115 V ac.

3.7.1.1.3.2 Physical Characteristics

The Synchros will be size 23.

3.7.1.1.4 Pointing Antenna Servo Motors (Azimuth and Elevation)

The Servo Motors control the pointing of the antenna reflector to the commanded position. The servo motors provide two axis control and allow pointing of the antenna in 360° in azimuth, and 180° in elevation from horizon to horizon.

3.7.1.1.4.1 Performance Characteristics

The motors will meet or exceed the following performance specifications:

a. Minimum speed greater than or equal to 2080 rpm.

b. Continuous stall torque equal to 5 ft.-lb.

c. Motor to be equipped with integral tachometer.

3.7.1.1.4.2 Physical Characteristics

The motors will meet the following physical characteristics:

a. Manual drive capacity on extended rear shaft.

b. NEMA C face on front and rear of motor.

c. Motor connectors to be military circular locking with male pins.

d. Motor power and data in separate connectors.

e. Output shaft to be configured in a keyway.

3.7.1.1.5 Pointing Antenna Servo Amplifiers (Azimuth and Elevation)

The Servo Amplifiers boost the analog signal from the PCU to the Servo Motors.

3.7.1.1.5.1 Performance Characteristics

The amplifiers will have the following capabilities:

a. Overspeed protection.

b. Current limit.

c. CW inhibit.

d. CCW inhibit.

e. Remote inhibit.

f. Torque control.

g. Velocity Control.

h. Overtemperature protection.

1. Motor speed pickoff.

j. Overcurrent protection for motor.

k. Motor/amplifier will be configured in a velocity feedback control loop. Input command to the motor will be a maximum 17.11 amps dc differential signal, with +1.0 ampere to result in a motor output torque of 3.04 in-lb. This control will be linear from maximum to minimum command voltage. The servo amplifiers will be capable of providing a minimum of 17.11 amps to the motor.

3.7.1.1.5.2 Physical Characteristics

The servo ampifiers shall occupy a maximum volume of 28 by 24 by 2 inches.

3.7.1.1.6 Pointing Antenna Limit Switches (Azimuth and Elevation)

The Limit switches will provide the capability to alert software and disable hardware when the antenna exceeds the designed limits if pointing. Limit switch will provide the following signals:

a. 28V to OV upon reaching 300° azimuth for software alert.

b. 28V to OV upon reaching 310° azimuth for amplifier disabling.

c. 28V to OV upon reaching 5° and 90° elevation for software alert.

d. 28V to OV upon reaching 0° and 95° elevation for amplifier disabling.

3.7.1.1.7 RESERVED

3.7.1.1.8 L-Band Low Noise Amplifiers (LNA)

The LNAs shall amplify the RF signal received from the satellite (4650). The LNA will introduce minimal noise into the signal.

3.7.1.1.8.1 Performance Characteristics
The pointing antenna LNA assembly will provide:

a. Redundant identical WA, electronically switchable.

b. Gain 34.00 dB min.

c. Gain Var. VS Freq. þ 0.25 dB max from 1.67-1.72 GHz.

d. Noise figure 0.60 dB max.

e. Power out 1dB comp 10.00 dBm min.

f. VSWR input 2.00:1 max.

g. VSWR output 2.00:1 max.

3.7.1.1.8.2 Physical Characteristics
The pointing antenna LNA assembly will conform to the following physical characteristics:

a. Size will be no greater than 3 by 4 by 6 inches (HxWxD).

b. Weight will be no greater than 5.0 lb.

3.7.1.1.9 Up/Down Converter Assembly

3.7.1.1.9.1 L-Band Down Converter (DC)
The Down converter shall convert the L-Band carrier (RF) signal from the satellite to a lower frequency carrier (IF), which is then sent to the Telemetry Receiver (1890). The L-Band down converter will accept inputs from 1615Mhz to 1715Mhz.

The Down Converter Assembly will provide:

a. Redundant electronically selectable down converters.

b. Down conversion will provide:

1. An IF response of 215-265MHz for an RF input of 1615-1715MHz.
2. 3.0 dB maximum noise figure.
3. 65 dB nominal conversion gain.
4. Input/Output VSWR of 1.5:1 maximum at 50W.
5. Power limiting at +13 dBm.

3.7.1.1.9.2 L-Band Up Converters (UC)

The Up Converter will receive an IF carrier frequency test signal from the IF modulator (which receives its input from the PCM simulator or the BERT) and will convert/modulate the signal to an RF frequency carrier of the L-Band. This RF signal will be output to the Test Probe antenna on the Antenna Reflector for use during Acquisition Subsystem testing.

The Up Conversion will provide:

a. An RF response of 1690MHz for an IF input of 240MHz.

b. Bandwidth 10MHz minimum.

c. Input power level of -20 to +13dBm.

d. Output power level internally adjustable to -50dBm.

e. LO rejection of 35dB minimum.

f. Input/output VSWR of 2.0:1 maximum.

3.7.1.1.9.3 Up/Down Converter Assembly Physical Characteristics

The Up/Down Converter assembly will be mounted such that unimpeded pointing to be required limits is provided.

3.7.1.1.10 RESERVED

3.7.1.1.11 Pointing Antenna Pedestal Control Unit Assembly
The Pedestal Control Unit (PCU) will provide for software control of the mechanical and electrical actions of the Pointing Antenna. The PCU consists of the components listed in the following paragraphs.

3.7.1.1.11.1 PCU Central Processing Unit Printed Circuit Board

3.7.1.1.11.1.1 Performance Characteristics
The Central Processing Unit (CPU) Printed Circuit Board (PCB) will contain the following:

a. A 28002 CPU.
b. 48K bytes of RAM.
c. 16K bytes of ROM.

3.7.1.1.11.1.2 Physical Characteristics
The CPU PWB will follow the physical form of the **VME** bus standard.

3.7.1.1.11.2 PCU **DAS/DACS** PCB

3.7.1.1.11.2.1 Performance Characteristics
The DAS/DACS PCB will provide the following functions:

a. An 8-bit TTL I/O port.

b. Sixteen channels of analog to digital conversion (ADC). This conversion will be 12 bits over the range **þ12V.**

c. Two channels of digital to analog conversion (DAC). This conversion will be 12 bits over the range **þ10V.**

3.7.1.1.11.2.2 Physical Characteristics

The DAS/DACS will follow the physical form of the VME bus standard.

3.7.1.1.11.3 PCU DIG/COM PCB

3.7.1.1.11.3.1 Performance Characteristics

The DIG/COM PCB will provide:

a. Two full duplex RS232 STD ports.
b. Two full duplex RS422 STD ports.

3.7.1.1.11.3.2 Physical Characteristics

The DIG/COM PCB will follow the physical form of the VMEbus standard.

3.7.1.1.11.4 PCU Bynchro Converter PCB

3.7.1.1.11.4.1 Performance Characteristics

Will provide conversion of two axis single speed 115 VAC/60Hz 3-phase signal into 14 bits of TTL information.

3.7.1.1.11.4.2 Physical Characteristics

Will conform to the physical form of the VMEbus standard.

3.7.1.1.11.5 PCU Computer Motherboard

3.7.1.1.11.5.1 Performance Characteristics

The computer motherboard will follow the VMEbus technical specification unique to backplanes.

3.7.1.1.11.5.2 Physical Characteristics

The computer motherboard will conform to the VMEbus standard for a seven slot backplane.

3.7.1.1.11.6 PCU I/O Motherboard

3.7.1.1.11.6.1 Performance Characteristics

Will provide for interconnection of any signal that must physically connect between the computer motherboard PCB and I/O connectors located on the physical enclosure.

3.7.1.1.11.6.2 Physical Characteristics
Will conform to the VMEbus standard physical requirements for backplanes.

3.7.1.1.11.7 PCU Power Module

3.7.1.1.11.7.1 Performance Characteristics
The power module will be capable of:

a. Supplying the following voltages:
   1. +5 VDC at 9.6 amps
   2. þ15 VDC at 5.6 amps
   3. +28 VDC at 3.1 amps
from 1 phase 115 VAC.

b. Will have one þ15VDC "hot" supply capable of powering the rest of the module upon receipt of a TTL latched signal.

3.7.1.1.11.7.2 Physical Characteristics
The PCU Power Module will conform to the following physical characteristics:

a) The size of the unit will be a maximum of 6 by 16 by 28 inches.

3.7.1.1.11.8 PCU Cooling Fans

3.7.1.1.11.8.1 Performance Characteristics
The performance characteristics for the PCU Cooling Fans will be to circulate sufficeint air to maintain a maximum temperature in the equipment enclosure of 50°.

3.7.1.1.11.8.2 Physical Characteristics
The PCU Cooling Fans will be capable of being housed within the power distribution module.

3.7.1.1.12 RESERVED

3.7.1.1.13 RESERVED

3.7.1.1.14 Fiber Optic Receivers and Transmitters

The Fiber Optic Receivers and Transmitters provide the conversion to and from the fiber optic links between the antennas and the Processing Area. The fiber optic link is transparent to the data path.

3.7.1.1.14.1 Performance Characteristics

The Fiber Optic Interface Assembly will be capable of transmitting and receiving the following signals:

a. An RF signal of 400 MHz bandwidth, amplitude of 1 volt pp maximum with noise floor less than -30dBm and input/output impedance of 50 ohms.

b. A minimum of five serial data streams by multiplexing. Each channel will be RS422 standard voltage levels, and less than 1M bit/sec capacity. In addition, each assembly will have a "hot" receiver ready at power on capable of receiving a latched TTL signal signifying sequenced power-on start.

3.7.1.1.14.2 Physical Characteristics

The fiber optic interface assembly will conform to the following physical characteristics:

a) The transmitters and receivers used for the analog signals will have a maximum size of 4 by 2 by 2 inches.

b) The transmitter/receiver multiplexer/demultiplexers will be contained in a volume of no larger than 8 by 6 by 12 inches.

3.7.1.1.1s Fiber Optic Cable

3.7.1.1.15.1 Performance Characteristics

Each fiber optic cable will provide the following:

a. Capacity for six optical fibers.

b. Attenuation will be less than 4dB/Km.

3.7.1.1.15.2 Physical Characteristics

Each fiber optic cable will conform to the following:

a. Be a minimum of 1500 ft. in length.

b. Will have connectors capable of passing through a waveguide 0.375 in. diameter.

c. Will have a strength member insert.

d. Will have an environmentally protective jacket.

3.7.1.2 Tracking Antenna

The Tracking Antenna provides the system the capability to receive data transmitted in either the S or L band from polar orbiting satellites (15700). The tracking antenna shall be able to track the polar orbiting satellite in either autotrack or program track enabling the reception of the transmitted data (440) (4580) (15590). The characteristics of the components of the Tracking Antenna are described in the paragraph below.

3.7.1.2.1 Tracking Antenna Reflector

The Antenna Reflector is a 10 foot diameter parabolic reflector with the RF pick-up at the focus. The tracking antenna will be capable of being switched (automatically via software control) between receiving L or S band signals. The reflector will be constructed so that it is assembled/disassembled in radial slices. There will be a test probe mounted on the antenna reflector that will allow the insertion of test data signal into the acquisition system.

3.7.1.2.1.1 Performance Characteristics

The lo-foot tracking antenna will provide:

a. 30.7 dBi of gain at 1680MHz with an output VSWR of 1.5:1 maximum 34.1 dBi of gain at 2200MHz.

b. Right hand circular polarization.

'c. 4.0° nominal 3dB beamwidth at 1680MHz, peak side lobes 18dB below mainlobe (Sum channel) 3.5° nominal 3dB beamwidth at 2200MHz, peak side lobes 18dB below mainlobe (Sum channel).

d. A sum channel response, as well as azimuth and elevation tracking responses.

e. A test probe for system testing.

3.7.1.2.1.2 Physical Characteristics

The lo-foot tracking antenna will conform to the following physical characteristics:

a. Diameter will be 10 ft.

b. Weight will be 300 lb maximum.

c. Surface tolerance will be 0.040 inch RMS maximum.

d. First natural resonant frequency will be $\geq$ 15Hz.

e. Reflector will be a minimum of eight assembled sections.

3.7.1.2.2 Tracking Radome and Pedestal Assembly

In the fixed site installations, the Radome is used to enclose the antenna reflector and the electronic equipment that comprise the antenna assembly. The interior of the Radome shall be environmentally controlled (4640). The Pedestal assembly is the mounting structure for the entire antenna assembly. It will be secured to mounting pads, supplied by the facility, and will be capable of supporting the antenna assembly in the required climatic extremes.

3.7.1.2.2.1 **Performance Characteristics**

The lo-foot pedestal will provide azimuth and elevation rotation per the following requirements:

	AZIMUTH	ELEVATION
	GEAR RATIO 390:1	TURN RATIO 1250:1
CONTINUOUS DRIVE TORQUE	1500 ft-lb	2500 ft-lb
PEAK DRIVE TORQUE (Intermittent Duty)	1500 ft-lb	2500 ft-lb
RATED GEAR STRENGTH	2000 ft-lb	2800 ft-lb
ANGULAR TRAVEL	+/-400^{o}	-5^{o} to +185^{o}
MAXIMUM VELOCITY	32^{o}/sec	20^{o}/sec
MAXIMUM ACCELERATION	12^{o}/sec^{2}	12^{o}/sec^{2}
COMPLIANCE	10'6 rad/ft-lb	10^{-6} rad/ft-lb
DATA PACKAGE	1 x syncro	1 x syncro
BACKLASH	0.04	0.04

3.7.1.2.2.2 Physical Characteristics

The lo-foot pedestal will conform to the following physical characteristics (weight and size).

a. The total weight of the unit will be less than 1500 lb.

b. The size of the unit will be such that the required tracking movments of the antenna reflector is supported.

The pedestal will be portable and designed for assembly/disassembly by two men. The pedestal will make maximum use of captive hardware.

3.7.1.2.3 Tracking Antenna Monopulse Converter

3.7.1.2.3.1 Performance Characteristics
The Monopulse Converter will provide:

a. A modulated signal, providing azimuth and elevation sum and difference outputs, for the lo-foot antenna received signal.

b. The dc power for the monopulse scan signals will enter the monopulse via a military qualified circular connector. This connector will be sealed to the monopulse case using an EM1 gasket material.

c. The dc power for the monopulse converter will be +5V dc, -15V dc and a dc return. The dc power and dc return will be isolated from the monopulse converter's case.

d. The line receiver IC inside the monopulse converter will be a DS78C20J/883B.

e. Insertion loss will be less than 1.9 db over the entire required frequency range.

3.7.1.2.3.2 Physical Characteristics
The covers for the monopulse converter's case will be sealed to the case using an EM1 gasket material.

3.7.1.2.4 Tracking Antenna Synchros (Azimuth & Elevation)
The Synchros will conform to the performance and physical characteristics of paragraph 3.7.1.1.3.

3.7.1.2.5 Tracking Antenna Servo Motors (Azimuth & Elevation)

The Servo Motors will conform to the performance and physical characteristics of paragraph 3.7.1.1.4.

3.7.1.2.6 Tracking Antenna Servo Amplifiers (Azimuth & Elevation)

The Servo Amplifiers will conform to the performance and. physical characteristics of 3.7.1.1.5.

3.7.1.2.7 Tracking Antenna Limit Switches (Azimuth & Elevation)

The Limit switches will provide the capability to alert software and disable hardware when the antenna exceeds the designed limits if pointing. Limit switch will provide the following signals:

a. 28V to OV upon reaching 300° azimuth for software alert.

b. 28V to OV upon reaching 310° azimuth for amplifier disabling.

c. 28V to OV upon reaching 5° and 180° elevation for software alert.

d. 28V to OV upon reaching 0° and 185° elevation for amplifier disabling.

3.7.1.2.8 RESERVED

3.7.1.2.9 Tracking Antenna Dual Band LNA

There will be two Dual Band LNA assemblies to provide for enhanced system reliability. The LNAs shall amplify the RF signal received from the satellite (4650). The LNAs will introduce minimal noise into the signal.

3.7.1.2.9.1 Performance Characteristics

The Tracking Antenna Dual LNA assembly will provide the following performance characteristics:

a. The Dual-Band (L & S) LNA assembly will be redundant. The on-line selection will be made automatically (via software control) to an electronic switch.

b. The L-band portion of the LNA assembly will provide performance per paragraph 3.7.1.1.8.

c. The S-band portion of the LNA assembly will provide:

1. Gain: 25.00 dB Min.

2. Gain Var.: VS Freq. ± 1.00dB Max from 1.6 to 2.3 GHz.

3. Noise Figure: 1.00 dB Max.

4. Power Out: 1dB Comp 10.00 dBm Min.

5. VSWR Input: 2.00:1 Max.

6. VSWR Output: 2.00:1 Max.

3.7.1.2.9.2 Physical Characteristics

The Tracking Antenna Dual LNA assembly will conform to the physical limits in 3.7.1.1.8.2.

3.7.1.2.10 Dual Band Up/Down Converter Assembly

3.7.1.2.10.1 L-Band Down Converter

There will be two L-Band Down Converters to provide for enhanced system reliability. The L-Band Down Converter will conform to the performance characteristics of paragraph 3.7.1.1.9.1.

3.7.1.2.10.2 S-Band Down Converter

There will be two S-Band Down' Converters to provide for enhanced system reliability. The Down converter will convert the S-Band carrier (RF) signal from the satellite to a lower frequency carrier (IF), which is then sent to the Telemetry Receiver (1890). The S-Band down converter will also accept inputs from 2200Mhz to 2300Mhz (1060).

The S-Band Down Converter will provide the following performance characteristics:

a. The S-Band Down Converter will be redundant. The on-line selection will be made automatically (via software control) by an electronic switch.

b. The S-Band Down Conversion will provide:

1. An IF response of 215-315 MHz for an RF input of 2200-2300 MHz.
2. 3.0 dB maximum noise figure.
3. 65 dB nominal conversion gain.
4. Input/output VSWR of 1.5:1 maximum at 50W.
5. Power limiting at +13 dBm

3.7.1.2.10.3 L-Band Up Converter

The Up Conversion data path can utilize the L-Band Up Converter or the S-Band Up Converter. The selected converter will be placed in-line automatically (via software control) by an electronic switch.

The L-Band Up Converter will conform to the performance and physical characteristics of paragraph 3.7.1.1.9.2.

3.7.1.2.10.4 S-Band Up Converter

The Up Conversion data path can utilize the S-Band Up Converter or the L-Band Up Converter. The selected converter will be placed in-line automatically (via software control) by an electronic switch. The Up Converter will receive an IF carrier frequency test signal from the IF modulator (which received it's input from the PCM simulator or the BERT) and will convert/modulate the signal to an RF frequency carrier of the S-Band. This RF signal will be output to the Test Probe antenna on the Antenna Reflector for use during Acquisition Subsystem testing.

The S-Band Up Conversion will conform to the following performance characteristics:

a. An RF response of 2250 MHz for an IF input of 240 MHz.

b. Bandwidth of 10 MHz minimum.

c. Input power level of -20 to +13 dBm.

d. Output power level internally adjustable to -50 dBm.

e. LO rejection of +35 dB minimum.

f. Input/Output VSWR 2.0:1 maximum.

3.7.1.2.10.5 Dual Band Up/Down Converter Assembly Physical Characteristics

The Up/Down Converter assembly will be mounted such that unimpeded pointing to be required limits is provided.

3.7.1.2.11 RESERVED

3.7.1.2.12 RESERVED

3.7.1.2.13 Tracking Antenna PCU Assembly

3.7.1.2.13.1 PCU CPU PCB

The PCU CPU PCB will conform to the performance and physical characteristics of paragraph 3.7.1.1.11.1.

3.7.1.2.13.2 PCU DAS/DACS PCB

The PCU DAS/DACS PCB will conform to the performance and physical characteristics of paragraph 3.7.1.1.11.2.

3.7.1.2.13.3 PCU DIG/COM PCB

The PCU DIG/COM PCB will conform to the performance and physical characteristics of paragraph 3.7.1.1.11.3.

3.7.1.2.13.4 PCU Synchro Converter PCB
The PCU Synchro Converter PCB will conform to the performance and physical characteristics of paragraph 3.7.1.1.11.4.

3.7.1.2.13.5 PCU Computer Motherboard PCB
The PCU Computer Motherboard PCB will conform to the performance and physical characteristics of paragraph 3.7.1.1.11.5.

3.7.1.2.13.6 PCU I/O Motherboard PCB
The PCU I/O Motherboard PCB will conform to the performance and physical characteristics of paragraph 3.7.1.1.11.6.

3.7.1.2.13.7 PCU Power Module
The PCU Power Module will conform to the performance and physical characteristics of paragraph 3.7.1.1.11.7.

3.7.1.2.13.8 PCU Cooling Fans
The PCU Cooling Fans will conform to the performance and physical characteristics of paragraph 3.7.1.1 11.8.

3.7.1.2.14 RESERVED

3.7.1.2.15 Fiber Optic Receivers and Transmitters
The Fiber Optic Receivers and Transmitters will conform to the performance and physical characteristics of paragraph 3.7.1.1.14.

3.7.1.2.16 Fiber Optic Cable
The Fiber Optic Cable will conform to the performance and physical characteristics of paragraph 3.7.1.1.15.

3.7.2 Sheltered (Enclosed) Equipment
The components of the MARX IV-B system that are housed within protective enclosures are described in the following

paragraphs. There are two enclosed areas within the MARK IV-B system, the Processing Area and the User Station Area.

3.7.2.1 Processing Area

3.7.2.1.1 **Acquisition Equipment**
The acquisition equipment shall be dual string, so that it can receive both geostationary and polar satellite data independently of each other (5110). The system shall be capable of receiving any of the three geostationary satellites with only software modification (1170). The frequency, bandwidth, demodulation, and decoding of the data from the satellite shall be automatically programmed based on the selection of the satellite type (4670) (4680) (4690) (4700). The equipment shall require no manual adjustments or manipulation during normal operation (4720). The acquisition equipment shall include enough hardware to receive and demodulate geostationary and polar satellites simultaneously (15690) (15710). The acquisition equipment shall include the capability to switch configuration, from a remote location, as required to receive a different satellite (15680). The system shall include RF test equipment which is to be controlled and monitored by the system control function (17510).

3.7.2.1.1.1 Antenna Control Unit
The System will contain two Antenna Control Units, one to control and interface to the Tracking antenna, and a second to control and interface to the Pointing antenna. The Antenna Control Unit (ACU) shall control the commands sent to the antenna assembly, monitor the status and position of the antenna, and report the status to the system control function located in the Input Computer (1900) (1910). The Input Computer will send antenna pointing/tracking commands to the ACU, and the ACU will transform these commands into a form that is usable by the Interface Assembly to control the Servos. The ACU will provide the capability for the tracking antenna to be capable of both an auto-track mode and a program track mode. The Input Computer interfaces to

the ACU via a RS-232 interface, which is used to initialize, command, and status the ACU.

3.7.2.1.1.1.1 Antenna Control Unit (ACU) CPU PCB

3.7.2.1.1.1.1.1 Performance Characteristics
Will conform to the performance characteristics of 3.7.1.1.11.1.1 .

3.7.2.1.1.1.1.2 Physical Characteristics
Will conform to the physical characteristics listed in 3.7.1.1.11.1.2 .

3.7.2.1.1.1.2 ACU DIG/COM PCB

3.7.2.1.1.1.2.1 Performance Characteristics
Will conform to the performance characteristics of 3.7.1.1.11.3.1 .

3.7.2.1.1.1.2.2 Physical Characteristics
Will conform to the physical characteristics of 3.7.1.1.11.3.2 .

3.7.2.1.1.1.3 ACU Status Monitor PCB
The ACU Status Monitor PCB will provide the capability to visually monitor all necessary ACU PCB test points, as required.

3.7.2.1.1.1.4 ACU Tracking Converter PCB
The ACU that controls the Tracking antenna will contain a Tracking Converter PCB. The following paragraphs describe the unit.

3.7.2.1.1.1.4.1 Performance Characteristics
The tracking converter will output a DC voltage for both azimuth and elevation that is proportional to the tracking error sum and different AM demodulated signals.

3.7.2.1.1.1.4.2 Physical Characteristics

Will conform to the physical form of the VMEbus standard.

3.7.2.1.1.1.5 ACU Front Panel Interface PCB

3.7.2.1.1.1.5.1 Performance Characteristics
The ACU Front Panel Interface will perform the following functions:

a. I/O memory mapped addressing for all components that constitute the ACU front panel.

b. Decoding of the pushbutton switch matrix on the ACU front panel.

3.7.2.1.1.1.5.2 Physical Characteristics
The ACU Front Panel Interface PCB will be 9 in. wide by 7 in. long.

3.7.2.1.1.1.6 ACU Display I/O PCB

3.7.2.1.1.1.6.1 Performance Characteristics
The ACU Display I/O PCB will perform the interfacing from TTL signals to display:

a. Three ten segment LED bar graph displays.

b. Ten single LED displays.

c. Two 5-digit eight segment alphanumeric displays.

3.7.2.1.1.1.6.2 Physical Characteristics
The design and placement of the display and controls on the unit will conform with the requirements of MIL-STD-1472C.

3.7.2.1.1.1.7 ACU Computer Motherboard

3.7.2.1.1.1.7.1 Performance Characteristics
The computer motherboard will follow the VMEbus technical specification unique to backplanes.

3.7.2.1.1.1.7.2 Physical Characteristics
The computer motherboard will conform to the VMEbus standard for a seven slot backplane.

3.7.2.1.1.1.8 ACU I/O Motherboard

3.7.2.1.1.1.8.1 Performance Characteristics
Will provide for interconnection of any signal that must physically connect between the computer motherboard PCB and I/O connectors located on the physical enclosure.

3.7.2.1.1.1.8.2 Physical Characteristics
Will conform to the VME standard physical requirements for backplanes.

3.7.2.1.1.1.9 ACU Power Module

3.7.2.1.1.1.9.1 Performance Characteristics
The power module will be capable of:

a. Supplying the following voltages:
   1. +5 VDC at 9.6 amps
   2. þ15 VDC at 5.6 amps
   3. +28 VDC at 3.1 amps
from 1 phase 115 VAC.

b. Will have one þ15VDC "hot" supply capable of powering the rest of the module upon receipt of a TTL latched signal.

3.7.2.1.1.1.9.2 Physical Characteristics
The ACU Power Module will conform to the following physical characteristics:

a) The size of the unit will be a maximum of 6 by 16 by 28 inches.

3.7.2.1.1.1.10 ACU Cooling Fans

3.7.1.1.1.1.10.1 Performance Characteristics

The performance characteristics for the ACU Cooling Fans will be to circulate sufficeint air to maintain a maximum temperature in the equipment enclosure of 50°.

3.7.1.1.1.1.10.2 Physical Characteristics

The ACU Cooling Fans will be capable of being housed within the power distribution module.

3.7.2.1.1.1.11 ACU *Front* Panel Switch Matrix

3.7.2.1.1.1.11.1 Performance Characteristics

The ACU Front Panel Switch Matrix will provide the following capabilities:

a. *A* 4x4 matrix of pushbutton switches and 4 single position momentary pushbutton switches.

b. Each matrix switch will be two position.

c. Each switch will illuminate to indicate its current position.

d. Switches will be color coded to meet the requirements of MIL-STD-1472C.

3.7.2.1.1.1.11.2 Physical Characteristics

The design and placement of the display and controls on the unit will conform with the requirements of MIL-STD-1472C.

3.7.2.1.1.2 Telemetry Receiver

The Telemetry Receiver shall demodulate the satellite data stream IF signal received from the antenna assembly (470) (1055) (1930). The system shall contain two receivers either of which can receive and demodulate any of the six satellite data types (1920) (4660) (15660) (15730). The Receivers shall provide programmable frequency, bandwidth and polarization settings to allow the reception of data from the six satellite sources (15720). The receivers will be programmable via the IEEE-488 interface and shall output status data on the IEEE-488 upon request from the Input Computer (1940) (4750) (15670) (15740).

3.7.2.1.1.2.1 Performance Characteristics

The telemetry receiver will provide reception and demodulation:

a. Center frequency tunable from 215-315 MHz in 100KHz steps.

b. Input impedance 50 ohms with a VSWR of 2.0:1 maximum.

c. Noise figure 8dB maximum.

d. Certified to meet MIL-STD-461B.

e. Have all major characteristics controllable through an IEEE 488 interface or front panel.

f. With simultaneous amplitude demodulation it will be capable of:

1. Phase demodulation switchable.

2. BPSK demodulation.

g. Will provide an Automatic Gain Control (AGC) output.

h. Will provide selectable filtering of AGC output.

i. Video output impedance will be 75 ohms .

j. Video output will be 4 Vp-p nominal.

k. Video frequency response will be ±1.0 dB through 5 MHz.

l. Will provide selectable filtering of video output.

m. AC power will be 115 VAC.

3.7.2.1.1.2.2 Physical Characteristics
The ACU will conform to the following physical characteristics:

a. Physical dimensions will be:

1. 19 in. wide rack mountable.

2. 7 in. height maximum.

3. 36 in. depth maximum.

b. Weight will be no more than 65 lbs.

3.7.2.1.1.3 Bit Synchronizer
The Bit Synchronizer shall receive the IF satellite data stream from the telemetry receiver, bit synchronize to the data, and shall output digital data and clock data to the selected Frame Synchronizer (15760). The data shall be prepared for decommutation and further processing before it is output to the Frame Synchronizer (480) (15750). The Bit Synchronizer shall be remotely programmable based on satellite selection via the IEEE-488 interface and shall output status on the IEEE-488 interface upon command (4760) (4770) (15770) (15780).

3.7.2.1.1.3.1 Performance Characteristics
The bit synchronizer will meet the following specifications:

a. Bit Rate: 1.0 bps to 3 Mbps minimum.

b. Signal source will be selectable from an available two sources.

c. Input signal:

1. Will be 0.5 V to 10 Vp-p minimum.

2. Will experience no degradation for baseline shifts of up to 100% p-p signal amplitude.

3. Input impedance will be 50 ohms.

d. Bit Synchronization: Will acquire signals within 5% of selected bit rate and S/N ratio of up to 12dB.

e. Phase-locked loop bandwidth.

f. Programming: All major functions will be controllable through an IEEE 488 interface or front panel.

g. Output Signals:

1. Data: will provide data output of TTL (+3V into 50 ohms) NRZ-L.

2. Clock: TTL bit rate clock (+3V into 50 ohms).

h. Input ac power 115 VAC

3.7.2.1.1.3.2 Physical Characteristics
The Bit Synchronizer will conform to the following physical characteristics:

a. Dimensions:
1. 19 in. rack mountable width.
2. 5.25 in. maximum height.
3. 36 in. maximum depth.

b. Weight will be no more than 45 lbs.

3.7.2.1.X.4 Frame Synchronizer

The MARK IV-B system will contain two Frame Synchronizers, either of which can be automatically (via software control) placed in-line for receiving a Polar or Geostationary satellite pass. The Frame Synchronizer will synchronize on the raw digital data stream and clock pulse from the Bit Synchronizer, and will partially unpack the data to allow the Input Computer to receive and process it (15980). The frame synchronizer shall lock-on to the data stream based on a programmable pattern recognition or criteria (16010). The data will be sent to the Input Computer via the DR11W interface. The Input Computer will initialize the Frame Synchronizer via the IEEE-488 bus and will command and status it via this interface. The Frame Synchronizer shall be capable of processing any of the three geostationary satellites by sending, via the IEEE-488 bus, the specific programmable parameters for the desired satellite (1170) (16000). The Input Computer shall command the Frame Synchronizer to process data from any one of the six satellite sources (1110) (1140) (1055) (15990) (16020). The system shall store pixels of zero value for the image contained during a time period of sync loss (16050).

3.7.2.1.1.4.1 Performance Characteristics

The Frame Synchronizer will conform to the following performance characteristics:

a. Inputs:
   1. Data will be NRZ-L.
   2. Clock will be 0° phase shifted.
   3. Level will be TTL.
   4. Rate will be lbps to 10 Mbps.

b. Frame/subframe synchronization. All parameters necessary to format/frame data for the protocols defined in MARE IV-B System Segment Specification SS-DMSP-907, paragraph 3.1.5.1 for:
   1. GOES I-M GVAR
   2. GMS S.VISSR

3. METEOSAT
4. DMSP RTD
5. DMSP RDS
6. TIROS

These parameters will be programmable/storable over an IEEE-488 STD interface.

c. Output will be up to 4K DMA blocks of data compatible with the DR11W interface timing, protocol, and signal levels.

d. Input power will be 115 VAC.

3.7.2.1.1.4.2 Physical Characteristics

a. Dimensions:
  1. 19" wide rack mountable.
  2. 5.25" high maximum.
  3. 36" deep maximum.

b. Weight will be no more than 65 lbs.

3.7.2.1.1.5 Time Source Equipment
The System shall have a time reference with an accuracy of 1 part in 10^{+7} per month. The timing equipment is described in the following paragraphs.

3.7.2.1.1.5.1 Global Position System (GPB) Receiver
The GPS receiver is used to give the system a very accurate reference time source (5370).

3.7.2.1.1.5.1.1 Performance Characteristics
The GPS Receiver will conform to the following performance characteristics:

a. Receive data from the GPS satellites and generate a reference time pulse (IRIG-B timing data) for input into the Time Code Translator.

b. Accurate to 1 in 10^{+7} parts in a 30 day period (5380).

c. Absolute accuracy of 0.1 seconds (5410).

d. The unit shall be accurate to 1 millisecond worldwide while receiving the external timing signal and 100 millisecond without the signal (16730) (16740).

e. The unit will contain a back-up battery power source that will maintain the clock operation for no less than 60 minutes.

f. The unit shall maintain the required accuracy for 30 days without any external timing source (5390) (5400) (16720).

g. Shall not lose any accuracy when the system loses external power or switches power sources (16750 (16760).

h. The MARK IV-B will contain the antenna required for the reception of the GPS signal.

i. The unit will be initialized, controlled and statused via the IEEE-488 bus.

3.7.2.1.1.5.2 Time Code Translator

The Time Code Translator will provide reference time to the Input Computer and to the Polar Antenna Control Unit.

3.7.2.1.1.5.2.1 Performance Characteristics

The Time Code Translator will conform to the following performance characteristics:

a. Shall receive the reference time in IRIG-B time format from the GPS Receiver.

b. Output a reference time (Universal Time Code ASCII format) on the IEEE-488 bus upon request.

c. The unit will be initialized, controlled, and statused via the IEEE-488 bus.

3.7.2.1.1.6 KG-44 Decyrption Device

The KG-44 shall be a GFE item that will decrypt polar satellite data from a DMSP satellite. The KG-44 shall be installed in accordance with the guidelines of NACSIM 5203 (770).

3.7.2.1.1.6.1 Performance Characteristics

The KG-44 Decryption Device shall conform to the performance characteristics as follows:

a. Decrypt the encrypted DMSP data (430) (530) (740) (750) (1055) (15950).

b. Decrypt the encrypted RTD and RDS data along with SSM/I, SSM/T, and SSM/T-2 data from the DMSP satellite (4920) (4930) (4940) (4950) (4960).

3.7.2.1.1.7 Switch Controller/Matrix

The Switch Controller along with the Switch Matrix shall provide the means to interconnect various components of the acquisition hardware, thus providing the MARK IV-B system flexibility in choosing the data path for receiving a satellite pass.

3.7.2.1.1.7.1 Performance Characteristics

The Switch Controller/Matrix will conform to the performance characteristics as follows:

a. The Switch Controller will control the interconnection (utilizing the Switch Matrix) of the following acquisition hardware units:

1. The output of the IF to IF Converter will be switchable between the transmitting Fiber Optic Module for the Polar ACU, and the transmitting Fiber Optic Module for the Geostationary ACU.

2. The output of the receiving Fiber Optic Module for the Polar ACU will be switchable between Telemetry Receiver # 1, Telemetry Receiver # 2, and the RF Power Meter.

3. The output of the receiving Fiber Optic Module for the Geostationary ACU will be switchable between Telemetry Receiver # 1, Telemetry Receiver # 2, and the RF Power Meter.

4. The output of Bit Synchronizer # 1 (data, clock and aux-1) will be switchable between Frame Synchronizer # 1, Frame Synchronizer # 2, KG-44 # 1, KG-44 # 2, and the BERT (15960).

5. The output of Bit Synchronizer # 2 (data, clock and aux-1) will be switchable between Frame Synchronizer # 1, Frame Synchronizer # 2, KG-44 # 1, KG-44 # 2, and the BERT (15960).

6. The output of KG-44 # 1 (data and clock) will be switchable between Frame Synchronizer # 1, and Frame Synchronizer # 2 (15960).

8. The output of KG-44 # 2 (data and clock) will be switchable between Frame Synchronizer # 1, and Frame Synchronizer # 2 (15960).

9. The input (time strobe) to the Time Code Translator will be switchable between Frame Synchronizer # 1, and Frame Synchronizer # 2.

10. The input (analog test data) to the Modulator will be switchable between the BERT and the PCM Simulator.

b. Those switches before the Telemetry Receivers will have a 400 MHz bandwidth, minimum.

c. All major functions of the Switch Controller will be front panel or IEEE-488 standard bus controllable.

3.7.2.1.1.7.2 Physical Characteristics
The Switch Controller/Matrix will conform to the physical characteristics of 5.25 by 19 by 36 inches H by W by D.

3.7.2.1.1.8 Power Module
The Acquisition equipment power module wil provide power control and switching as required for the Acquisition sub-system. It will also contain DC power supplies which provide DC voltages to the equipment requiring it.

3.7.2.1.1.9 Test Group
The Test Group for the Acquisition Hardware equipment will consist of the RF Power Meter, Bit Error Rate Tester (BERT), Pulse Code Modulation (PCM) Simulator, Modulator, and IF to IF Converter.

3.7.2.1.1.9.1 RF Power Meter
The RF power meter will provide the system with a measurement of the signal strength of the satellite signal that is being received. It will be initialized, commanded, and statused via the IEEE-488 bus.

3.7.2.1.1.9.1.1 Performance Characteristics
a. Be capable of pulsed power measurements between -40 and +10 dBm, 1-4GHz minimum.

b. Will have all major functions controllable through front panel or an IEEE 488 standard bus interface

The PCM Simulator will output a modulated test pattern that will be up converted to a test probe antenna on one of the satellite antenna reflectors, then brought into the system, down converted, demodulated, bit synchronized, and frame synchronized. The Input Computer will then analyze the test data and report the results.

3.7.2.1.1.9.3.1 Performance Characteristics

The PCM Simulator will conform to the performance characteristics as follows:

a. Once powered on, a continuous data stream will be output to the switch matrix.

b. The output data will be:

1. A minimum of a 256 bit repeatable pattern.

2. A data rate of up to 5 Mbit/sec.

3. BPSK modulated on a 70 MHz carrier of -10dBm strength.

3.7.2.1.1.9.3.2 Physical Characteristics

The PCM Simulator will be 7 by 19 by 36 (H by W by D) maximum dimensions.

3.7.2.1.1.9.4 RESERVED

3.7.2.1.1.9.5 IF to IF Converter

The IF to IF Converter will accept the IF carrier from the Modulator and output a higher frequency IF carrier which will be acceptable to the L or S Band Up Converter.

3.7.2.1.1.9.5.1 Performance Characteristics

The IF to IF Converter will conform to the following performance characteristics:

a. Once powered on, a continual IF carrier will be output.

b. The output IF carrier will be match the frequency and characteristcs of the down-converted satellite data stream.

3.7.2.1.1.9.5.2 Physical Characteristics

The IF to IF Converter will be a standard 19" rack mounted unit with maximum dimensions of 5.25 by 19 by 36 (H by W by D).

3.7.2.1.1.10 Fiber Optic Transmitters and Receivers

The communication between the acquisition equipment and the antenna equipment uses fiber optics. The characteristics of the fiber optic transmitters and receivers is described in 3.7.1.1.19 .

3.7.2.1.2 Input Computer

The input computer shall accept demodulated, partially decoded, satellite data from the frame synchronizer (15930). The Input Computer will process the satellite data in preparation for use by the Product Computer, and will output the processed data to the Parallel Disk Unit. The Input Computer will consist of the following major hardware components:

a. Four 68030 CPU boards
b. Two 16 Mbyte RAM boards
c. Parallel disk host adapter
d. MultibusMultibus Interface board
e. DR11W interface boards
f. Two IEEE-488 interface board
g. ESDI peripheral interface board
h. 5.25" floppy disc drive
j. Two 763 Mbyte hard disc drives
k. VMEbus interface board pair
m. Main computer chassis

Each of these components will be described in 3.7.2.1.4 and sub-paragraphs.

3.7.2.1.3 Product computer

The Product Computer will consist of the following hardware components:

a. Three 68030 CPU boards
b. Three Numeric Coprocessor daughter boards
c. Two 16 Mbyte RAM boards
d. Parallel disk host adapter
e. Multibus to Multibus Interface board
f. Multibus Repeater
g. Serial Multiplexer board
h. ADCCP interface board
j. Two IEEE802.3 and X.25 interface boards
k. Two Video Display controller board sets
l. ESDI peripheral interface board
m. SMI to VMEbus interface board pair
n. 5.25" floppy drive
o. Two 763 Mbyte hard drive
q. Main computer chassis and Power Supply
r. Multibus Expansion chassis

Each of these components will be described in 3.7.2.1.4 and sub-paragraphs.

3.7.2.1.4 Computer Characteristics

Extensive hardware evaluation preceded the selection of the MASSCOMP 6600 for the MARK IV-B Input and Product computers. The MARK IV-B MASSCOMP computer hardware and its associated peripherals are presented in detail in the following paragraphs.

3.7.2.1.4.1 Chassis

Both the MASSCOMP 6600 expansion and computer chassis are 12.25 in. H by 19.00 in. W by 30 in. D and weigh approx. 150 pounds (depending on specific card content). Each computer chassis contains backplanes for several bus structures, can hold up to 15 user cards and one system card, provides a 140-Amp, 5-Volt power supply, and includes fans for card and power supply cooling. Placement of cards in the backplanes is a function of power consumption, heat dissipation, and bus loading. The expansion chassis contains a Multibus backplane and a Multibus repeater board.

3.7.2.1.4.2 Buses

The MASSCOMP 6600 main chassis for each of the two MARK IV-B computers contain four physical buses, Synchronous Memory Interconnect (SMI) bus, Virtual Memory Expansion (VME) bus, and two Multibuses. All main chassis cards are connected to a single 26.6 Mbytes/sec Synchronous Memory Interconnect (SMI) backplane and to one of two Multibus backplanes or the VME bus. Bus contention is mediated by an auxiliary function module (AFM) board. The expansion chassis only contains a single Multibus backplane and does not contain an SMI bus backplane or an AFM. Two of the 68030 CPUs will be configured in the main chassis on the SMI bus such that one CPU will physically reside on each of the main chassis Multibus backplanes (since the Multibus Bus Interface Unit [BIU] is physically part of the CPU card).

3.7.2.1.4.3 Power Supply

The MASSCOMP 6600 power supply provides +5V at 140A, +12V at 16A, -12V at 5A, and -5.2V at 5A regulated power and +16V at 4A, -16V at 4A, and 24V at 2A unregulated power. An internal power-up power supply is incorporated. The power supply is a single modular unit with its own cooling source. A tube axial fan evacuates out of the top rear of the chassis. The regulated +5V provides power to the Multibus. The unit accepts 90-132 VAC, 47-63 Hz. Power factor is .75 typical.

3.7.2.X.4.4 Cooling

Air is drawn in through the front of the chassis and exhausted out the rear. The internal fans in each chassis move 260.5 cubic feet per minute (CFM) air flow through the unit, providing necessary cooling.

3.7.2.1.4.5 Cards

Figure 13 and Figure 14 show the selected card layout for the chassis of the MASSCOMP 6600 for the MARX IV-B Input and Product Computer configurations. The specific card layout shown meets power, bus loading, and other system requirements. The power consumption is easily satisfied by the chassis power supplies. The cards selected for the MARX IV-B are discussed separately below.

VMEBUS in the Main Chassis

Slot Number	BOARD DEFINITION
1	SMI to VMEbus I/F
2	JUMPER
3	C51 Host Interface Board
4	JUMPER
5	Serial MUX Board
6	JUMPER
7	ADCCP I/F Board
8	EMPTY
9	EMPTY
10	EMPTY
11	EMPTY

MULTIBUS I in the Main Chassis

Slot Number	BOARD DEFINITION
1	EDSI Controller
2	CPU #1
3	EMPTY
4	M-bus to M-bus I/F
5	EMPTY
6	M-Bus Repeater
7	16Mb RAM #2
8	CPU #2
9	EMPTY
10	CPU #3
11	EMPTY
12	EMPTY
13	SMI to VMEbus I/F
14	EMPTY
15	16Mb RAM #1
16	Aux Function Module

MULTIBUS I in the Expansion Chassis

Slot Number	BOARD DEFINITION
1	X.25 and IEEE802.3
2	EMPTY
3	X.25 and IEEE802.3
4	EMPTY
5	EMPTY
6	EMPTY
7	GA1000 (User)
8	8-Plane Video RAM
9	8-Plane Video RAM
10	8-Plane Video RAM
11	M-Bus Repeater
12	EMPTY
13	EMPTY
14	EMPTY
15	GA1000 (Operator)

FIGURE 13 – PRODUCT COMPUTER CARD SLOT CONFIGURATION

VMEBUS in the Main Chassis

Slot Number	BOARD DEFINITION
1	SMI to VMEbus I/F
2	EMPTY
3	C51 Host Interface Board
4	EMPTY
5	EMPTY
6	EMPTY
7	EMPTY
8	EMPTY
9	EMPTY
10	EMPTY
11	EMPTY

MULTIBUS I in the Main Chassis

Slot Number	BOARD DEFINITION
1	DR11W I/F #1
2	CPU #1
3	IEEE-488 I/F #1
4	M-bus to M-bus I/F
5	EMPTY
6	EDSI Controller
7	16Mb RAM #2
8	CPU #2
9	EMPTY
10	CPU #3
11	IEEE-488 I/F #2
12	SMI to VMEbus I/F
13	DR11W I/F #2
14	CPU #4
15	16Mb RAM #1
16	Aux Function Module

FIGURE 14 – INPUT COMPUTER CARD SLOT CONFIGURATION

3.7.2.1.4.5.1 CPU Cards

Each CPU card will contain a Motorola 68030 processor operating at 33 MHz. The CPUs in the Input Computer contain a Motorola 68882 floating point coprocessor, while the CPUs in the Product computer contains a Numeric Coprocessor daughter board for each CPU as described below. Each CPU card can process approximately 6 million instructions per second (MIPS). All CPUs will reside on the SMI bus and have access to any address in the entire system: any CPU may read/write over any primary bus without overhead penalty. CPUs share all processing tasks, under Operating System control, unless they are specifically set aside by application software command for a particular task. One of the CPUs will always be configured as the master CPU, while all other CPUs are slaves to that Master. If the master CPU fails, then another CPU can be reconfigured as the new master, and computing can continue. An entire CPU can stop functioning, and the system, with some reconfiguration, can still accomplish all functions (although in a degraded mode).

3.7.2.1.4.5.2 Numeric Co-Processor Daughter Board

The product computer CPUs contain a Super Lightning Numeric Coprocessor board for each of the three CPU's. The Numeric Coprocessor provides greatly increased floating point computation speed, and intrinsic function speed (i.e. SIN, TAN, LOG, etc.)

3.7.2.1.4.5.3 Memory Cards

The MASSCOMP 6600 uses a global physical memory. All physical memory is accessible to all processors. The operating system dynamically allocates the memory among processes according to need. A well-designed cache on each processor improves performance by reducing the number of memory accesses. The high-speed SMI bus provides for 256 Mbytes of physical address space. 128 Mbytes is allocated for memory address space, and the other 128 Mbytes is reserved for multibus address space. As currently configured, each MARK IV-B computer will be delivered with two 16-Mbyte memory boards for a total of 32 Mbytes for each computer.

3.7.2.1.4.5.4 Multibus Repeater Cards
These cards extend one of the Multibuses in the main computer chassis into an expansion chassis. The expansion chassis is interconnected to the main computer chassis by a pair of multibus repeater cards: however, the cable length between repeater cards is limited to 10 feet. For this reason, both MARK IV-B chassis are contained within the single rack cabinet. Since the presence of Multibus repeater cards is transparent to all user and system software, all devices and peripherals linked to the main chassis through Multibus repeater cards are addressed the same as if they were attached to one of the primary Multibus backplanes. Bus repeater cards do, however, add 20 percent to 30 percent to the time it takes to get data from point to point through them. As a result, high bandwidth items such as disk controllers are placed in the main computer chassis. The card layouts as shown in Figure 10 take this into account.

3.7.2.1.4.5.5 High-Resolution Video Card Sets
The graphics cards used in the MARK IV-B system are the MASSCOMP GA1000 high-performance interactive color graphics/imagery subsystem. These cards provide alphanumeric, graphic, and imagery display capability. The basic GA1000 board includes four 1024 x 1024 by 8 bit planes each for dynamic graphics display. The GA1000 for the user station display has three boards added to the set, each containing eight 1024 x 1024 by 8 bit video memory planes. Each of these video memory planes contain two buffers. Fast updates are possible, since one buffer can be filled with data while the other is displayed. Graphics processors have their own 16.7-MHz 68020 microprocessor and a 256-KB graphics program memory. The dedicated graphics processor and software perform display list input and graphics generation, offloading the majority of compute-intensive processing from the system CPUs. Graphics processors use

high-speed direct memory access (DMA) transfer operations to obtain graphics commands from the system's main memory. Total system performance is improved by reducing the graphics load on both the system CPUs and the system bus. Graphics processor memory can be configured as either 4, 12, or 28 double-buffered planes (8, 24, or 56 total planes), where each plane is 1024 x 1024 pixels. The specific BARK IV-B configuration provides 4 double-buffered memory planes for the operator station and 28 for the user station.

3.7.2.1.4.5.6 Enhanced Small Device Interface Peripheral Controller

The BARK IV-B computer systems contain an Enhanced Small Device Interface (ESDI) mass storage controller card. The controllers control the system hard disks, the floppy disks, (and the 1/4-in. cartridge tape units, for the DTT).

The controller will perform as described in the vendor manual:

XYLOGICS Model 43x Peripheral Controller User's Manual; July 1988

3.7.2.1.4.5.7 RESERVED

3.7.2.1.4.5.8 IEEE-488 Controller

The National Instrument GPIB 796 card is a high-performance interface that supports DMA transfers to and from multibus memory at speeds up to 500 Kbytes per second. Data block lengths can be up to 64 Kbytes. The IEEE-488 bus interface is used in the MARK IV-B system to command/control/status the Acquisition Equipment connected to the Input Computer (1980).

The controller will perform as described in the vendor manuals:

NATIONAL INSTRUMENTS GPIB-796 User's Manual For Revision C Circuit cards (P/N 320010-01) April 1985

MASSCOMP NI-488/GPIB-796 Installation For the Masscomp MC-500 with RTU-01 (P/N 320056-01) Sept 1985

3.7.2.1.4.5.9 Asynchronous Serial I/O Controller (RS-232D MUX) Cards
A high-performance serial multiplexer card supports sixteen full duplex lines at rates up to 38.4 kbps Each port is independently programmable, and can support asynchronous modems. There shall be no less than four of these ports configured as spares (1530).

The controller also provides two synchronous ports, and a diagnostic port. The diagnostic port is connected to one of the MASSCOMP CPU's serial port, for use during BIT and maintenance.

The controller will perform as described in the vendor manual:
RADSTONE SIO-4 Intelligent Serial I/O Controller Technical Reference Manual: (Pub No. 421/HH/24937) Issue 1, Dec 1988

3.7.2.1.4.5.10 ADCCP Interface Board
The ADCCP interface board shall provide for the receipt of data from the AWN/CFEP external communication link. The data rate of the interface shall not exceed 9.6 Kbaud.

The board will perform as described in the vendor manual:
SIMPACT ADCCP NRM Programmer's Guide: (DC900-0115D), March 1989

3.7.2.1.4.5.11 IEEE802.3 and X.25 Interface Board
This board shall provide the interface for two external communication links. The Local AWDS link uses the IEEE802.3 interface. The Tactical Decision Aid (TDA) link shall use the X.25 interface.

The board will perform as described in the vendor manual:

COMMUNICATION MACHINE CORPORATION MNP-30 Multifunction Node Processor Installation Guide

3.7.2.1.4.5.12 Multibus to Multibus Interface Board

The Multibus to Multibus interface boards provide a fast interface for the transfer of data between the Input and the product computer. The boards provide a software transparent memory space that appears to the software like it is shared between the two computers.

The board will perform as described in the vendor manual:
BIT 3 Multibus I to Multibus I Adapter Model 421 Manual

3.7.2.1.4.5.13 DRllW Interface Board

The DRllW interface board provides the interface that the input computer receives the demodulated satellite data from the acquisition equipment (1970). The input computer has two of these boards in it, one for the ingest of polar and one for the ingest of geostationary data. The board will have a data transfer rate of no less than 1 MByte/sec. It will be compatible with the industry standard DRllW interface, and will be hosted on the Multibus in the MASSCOMP.

The board will perform as described in the vendor manual:
MASSCOMP IKON 10077 Hardware/Software Manual - Multibus DRllW Emulator

3.7.2.1.4.5.14 Parallel Disk Host Adapter Board

The Parallel Disk Host Adapter board provides the interface between the VMEbus in the MASSCOMP, and the Parallel Disk subsystem. It will support a burst data transfer rate of no less than 10 Mbyte/sec.

The board will perform as described in the vendor manual:
STORAGE CONCEPTS VME/HD/51 Host Adapter User Guide

3.7.2.1.4.5.15 VME to BMI bus Interface Adapter Boards

Each of the MASSCOMP computers contains a SMIbus and a VMEbus. The interface between these buses consists of a board resident on each bus, which provide two way communication between them. The available bandwidth between these buses will be no less than 20 MByte/sec.

3.7.2.1.4.6 Peripherals

Each device is discussed separately as follows.

3.7.2.1.4.6.1 Floppy Disk Drive

The l-megabyte, 5.25-in. floppy disk drive is a double-sided, double-density drive. Formatted capacity is 655.36 Kbytes. Average track-to-track access time is 158 ms, rotational latency is 100 ms, settle time is 15 ms, and head load time is 35 ms. Data transfer rate is 250 Kbits/sec. The operator shall have access to this device, which provides him a removable storage media (2270).

The disk drive will perform as described in the vendor manual:

TEAC Model FD-55GFR-340/440/540 Mini Flexible Disk Drive Specification - Rev. C

3.7.2.1.4.6.2 RESERVED

3.7.2.1.4.6.3 Hard Disk Drive

Both the Product and Input computers contain two 766-Mbyte ESDI drives. There are currently two interchangeable choices for the drives, Micropolis and Control Data Corporation (CDC).

The disk drives will perform as described in the vendor manual:

MICROPOLIS Product Description 1560 Series 5.25" ESDI 760MB 15Mhz Rigid Disk Drive

or

CONTROL DATA Wren VI ESDI Model 94196 disk drive OEM Manual

3.7.2.1.5 **RESERVED**

3.7.2.1.6 Parallel Disk Subsystem

The Parallel Disk Subsystem is the main data storage device in the system. It will store no less than 10 Gbytes of data. It will be fault tolerant and will contain BIT to diagnose and isolate failures. The subsystem will be interfaced to both the Input and the Product Computer. The access time and data transfer rate of the subsystem will support the processing and timeline requirements of the system.

The disk subsystem will perform as described in the vendor manuals:

STORAGE CONCEPTS Concept 51 Product Description; May 1988

STORAGE CONCEPTS Concept 51 Technical Description: Nov 1988

STORAGE CONCEPTS Concept 51 Disk Processor Systems User's Guide

STORAGE CONCEPTS Concept 51 Command Description; Rev 3.14

STORAGE CONCEPTS Differential Fast Bus Interface Manual; Rev 1.0, May 1988

3.7.2.1.7 Operator Station

The operator station will provide an interface to the system for routine operations and testing/trouble-shooting. The operators station will consist of a video display, keyboard, and mouse (16590). The station will provide configuration information and control, and the capability to initiate and monitor testing.

3.7.2.1.7.1 Video Monitor

The Video Monitor at the operators station shall display a 1024 by 1024 full color display with a 60Hz refresh that shall contain all data required to perform the operators functions (2280). The display shall be capable of being used while the operator is wearing NBC protective masks (5610).

The Video Monitor will perform as described in the vendor manuals:
CANDES User Guide For Model 7351 19" RGB Color Monitor (CONRAC)

CANDES Model 2119T 19" RGB Color Monitor Installation and Operating Instructions: April 1987

3.7.2.1.7.2 Keyboard and Mouse
The Keyboard and Mouse at the operators station shall provide the means to input the required actions to perform the operators functions (2250) (2260). The alphanumeric portion of the keyboard shall meet the requirements of MIL-STD-1280 (16600). The keyboard shall have no less than 10 user programmable function keys and shall support no less than the 96 ASCII character set (16610).

3.7.2.1.7.3 Audible Alarm
An Audible Alarm shall be provided at the operator station for indication to the operator the a fault/failure, requiring immediate action, can be given. The pitch and tone of this alarm shall be adjustable under software control (16820).

3.7.2.1.8 Processing Area Uninterruptible Power System
The Processing Area Uninterruptible Power System (UPS) in the processing area shall provide the system with clean, high quality, uninterrupted power during operation (610) (5750). The UPS shall condition the primary local power (5760). The UPS shall continue to provide power to the system in the event of a primary power failure until the system can be shut down or until primary power is restored. The UPS shall supply power for up to 5 minutes, with growth for power up to 15 minutes (5770) (5780). THe UPS shall have a load capacity of at least 125% of the worst case

maximum load of the system (5800). The UPS does not supply back-up power to the ECU or the Antennas (5790).

The UPS will perform as described in the vendor manuals:
BEST POWER Ferrups FC7.5, FC10, FC15KVA Owner's Manual (LTSB337); Jan 1989

BEST POWER FC7.5, FC10, FC15KVA Options Technical Information: Jan 1989

BEST POWER FC7.5, FC10, FC15KVA Service Manual; April 1989

3.7.2.1.9 Analog Environmental Sensors

The Environmental Sensors will provide inputs to the PEMU of the local outdoors climate and the processing area climate. The sensors will measure the temperature and humidity inside and outside the system, and measures the barometric pressure inside the processing area. The sensors will output signals to the PEMU which convert them into digital data and outputs it to the Data Archive Computer. The three sensor units are described below;

A. Processing area temperature and humidity.

The sensor unit will be a wall mounted package with 115 VAC power supplied to it, and with outputs of two 4-20 Ma signals, one for temp. and one for humidity. The accuracy of the unit will be +/- 0.4^{o}F and +/- 2%RH. The range of measurement of the unit will be -30^{o}C to +70^{o}C for the temperature, and 0 to 100% for the relative humidity.

B. Processing area Barometric pressure

The sensor unit will be a wall mounted package with 12 VDC power supplied to it, with an output signal of 2.9 to 5.31 volt DC corresponding to a measurement range of 600 to 1100 Mb. The accuracy of the unit will be +/-.9 Mb. The unit will operate over an ambient temperature range of $-10^{o}C$ to $+50^{o}C$.

C. Outdoors ambient temperature and humidity

The sensor unit will be a wall mounted package with 115 VAC power supplied to it, and with outputs of two 4-20 Ma signals, one for temp. and one for humidity. The unit will be mounted on the inside of an exterior wall, with a one inch diameter penetration through the wall for the sensor probe to reach the outside environment. The accuracy of the unit will be +/- $0.4^{o}F$ and +/- 1.5%RH. The range of measurement of the unit will be $-50^{o}C$ to $+150^{o}C$ for the temperature, and 0 to 100% for the relative humidity.

3.7.2.1.10 Power Entry Panel

The Power Entry Panel will be the entry point for the primary power to the system. It shall protect the system from power surges, HEMP effects, and electromagnetic environmental effects (E^3). The power entry panel shall accept power from any outside source of three-phase power, 120/208 volts +/-10%, at 50/60 Hz +/-5%. Voltage waveform deviation factor shall not exceed ten percent and maximum transient voltage amplitude (for period under five millisec) shall not exceed +/-30 percent of nominal.

3.7.2.1.11 Signal Entry Panel

The Signal Entry Panel will be the entry point for the signals to and from the Processing Area. It shall protect the system from surges, HEMP effects, and E^3 effects.

3.7.2.1.12 Environmental Control Unit (ECU)

The ECU shall control the environment within the processing area to allow normal operation of the system and comfort of the operating personnel (600). The ECU shall be equipped with replaceable air filters that shall have a minimum air filtration efficiency of 70% per the paragraph of F-F-310 entitled "Filter, Two Inch Nominal Thickness" and be tested in accordance with paragraphs of the same specification entitled "Test Procedure", "Initial Efficiency" and "Dirt Holding Capacity" (5420) (5430).

3.7.2.1.13 Processing Area Enclosure

The MARE IV-B system equipment shall be housed within an enclosure that will provide protection from E^3 effects and all environmental conditions as specified herein (602) (604). The MARE IV-B system shall not have any TEMPEST requirements (606).

3.7.2.1.14 Power Distribution System

The power distribution system of the MARE IV-B shall provide power to all equipment as needed. It shall ensure the orderly power-up and power-down of the system equipment (16960). It shall permit the power-up of the system by a single operator/user action from a remote location or the user station (16950) (16970).

3.7.2.1.15 Processing Area To User Station Fiber Optic Link

The Fiber Optic Receivers and Transmitters will provide the conversion to and from the fiber optic links between the antennas and the Processing Area. The fiber optic link will be transparent to the data path.
The function and performance of the fiber optic transmitters and receivers will be as described in the following vendor documents:

OPTELECOM Model 5000A and 5000E Rack Mounted Chassis User's Manual (P/N: UM-8J) Jan 1986

OPTELECOM System 5000 Power Supplies User's Manual (P/N: UM-8F) Oct 1987

OPTELECOM Models 5050, 5051, and 5052 High Speed Fiberoptic Analog Transmitter/Receiver Units, System 5000 Compatible (P/N: UM-25) Jan 1985

OPTELECOM Model 504x RS-423/TTL Fiber Optic Transmitter/Receiver, System 5000 Compatible (P/N: UM-31) March 1986

OPTELECOM Model 5060 RS-232 and RS-422 6-Channel Multiplexer User's Manual (P/N: UM-59) Dec 1987

OPTELECOM Model 5005A I-Channel Interface Harness (P/N: UM-81(1)) July 1986

OPTELECOM RGB/Triple CVBS Fiber Optic Transmission System Models 3252TTT and 3252RRR and Models 5052TTT and 5052RRR (P/N: UM-56) July 1988

3.7.2.2 User Area

The equipment that will make up the User Area are described in the following paragraphs. The user station shall consist of a video display, keyboard, and mouse (12240). The user station shall be comfortably operated (12260). The user station can be located within the local weather facility.

3.7.2.2.1 Video Monitor

The Video Monitor at the users station shall display a color image of 1024 by 1024 or 512 by 512 pixel display with a refresh rate of 60 Hz, that shall contain all data required to perform the user and operators functions (4390) (12320). A single pixel of a 512 by 512 display shall be visually locatable (12340). The display area shall be no less than 10 inches vertical by 10 inches horizontal (12310) (12470). The display shall be capable of being used while the user is wearing an NBC protective mask (5610). The unit shall have user adjustable brightness and contrast (12350). The adjustment of the brightness and contrast shall not affect the display operation (12590).

The video monitor will perform as described in the vendor manuals:
CANDES User Guide For Model 7351 19" RGB Color Monitor (CONRAC)

CANDES Model 2119T 19" RGB Color Monitor Installation and Operating Instructions: April 1987

3.7.2.2.2 Keyboard and Mouse

The Keyboard and Mouse at the user station will provide the means to input the required actions to perform the operator functions. The alphanumeric portion of the keyboard shall meet the requirements of MIL-STD-1280 (12530). The keyboard shall have no less than 10 user programmable function keys and shall support no less than the 96 character ASCII set (12540) (12550). The mouse shall provide the user the capability to move the cursor to a single element on the video display (12520).

3.7.2.2.3 Color Printers

The Color Printer shall provide the system with the capability to produce high quality, high resolution color, or gray scale hard copies of products as commanded by the user (2290) (4400). The resolution of the printer shall be no less than that of the video display and shall be no less than 300 pixels per inch (15090) (15110). The printer shall support no less than 128 separate colors (15120). The printer shall support no less than 32 gray shades when operating in monochrome mode (15100). The image size shall be no less than 8 by 8 inches on an 8.5 by 11 inch media (15140). The image shall remain usable after one hour of exposure to full sunlight (15150). The user station will have two color printers, of which one will be in use at any given time, with the other configured as a spare. There is a user controlled manual switch that controls which of the two printers is the one in use.

The printer will perform as described in the vendor manuals:
SEIKO CH5500 Color Printers Parallel Interface Technical Specification (Doc No. C3-MTS03), March 1989

SEIKO CH5500 Color Printers Parallel Interface User's Guide (Doc No. C5-MUG02), March 1986

SEIKO CH5500 Color Printers User's Quick Reference Guide

SEIKO CH5500 Color Printers Print Engine Technical Specification (Doc No. C3-MTS01), Dec 1988

SEIKO CH5500 Color Printers Video Interface Technical Specification (Doc No. C5-MTS02), Dec 1988

SEIKO CH5500 Color Printers Modified Centronics Parallel Interface Programming Manual (Doc No. C3-MPM01)

3.7.2.2.4 Data Archive Computer

The Data Archive Computer will perform the archive of user selected data and will provide the control of the color printers. The image to be printed will be sent to the Data Archive computer from the Product computer, and then to the Printer from the Data Archive Computer. The data to be archived will be sent to the Data Archive computer from the Product Computer, and then to the Archive tape for storage.

The unit will perform as described in the vendor manuals:
SEAGATE ST138R Disk Drive Product Manual; (Man No. 36045-002), Rev D, May 1989

WESTERN DIGITAL WD1006V-SR2 Winchester/Floppy Disk Controller: (Doc No. 79-000291), May 1988

MICROFRAME 386 AT Motherboard Hardware Installation and Technical Reference Manual: June 1988

WYSE WY-995 Intelligent Multiuser Interface Board User's Guide

3.7.2.2.S RGB to NTSC Video Converter/Encoder

The RGB to NTSC converter/encoder will receive the high-resolution video from the Product Computer, and shall output standard NTSC RS-170 format video that is compatible with standard commercial video equipment (12560) (12250).

The unit will perform as described in the vendor manuals:
FOLSOM Monarch Color Graphics Converter Model 8708 Technical Manual (P/N 8708904), July 1989

FOLSOM Monarch Color Graphics Converter Model 870862, Operating Instructions; July 1988

3.7.2.2.6 User Area Uninterruptible Power System

The UPS in the user station area shall provide the system with clean uninterrupted power during operation (5750). The UPS shall condition the local primary power (5760). The UPS shall continue to provide power to the system in the event of a primary power failure until the system can be shut down or until primary power is restored. The UPS shall supply power for up to 5 minutes with growth of up to 15 minutes (5770) (5780).

The UPS will perform as described in the vendor manuals:
BEST POWER Options for the RM1,1.5, and 2 KVA Micro-Ferrups Models, Technical Information (TIR 136, 144, 122, 245, 350) March 1989

BEST POWER RM1-2KVA Rackmount Owner's Manual; Feb 1989

BEST POWER Owner's Installation and Operation Manual for RM1, 1.5, and 2 KVA models; Feb 1989

BEST POWER RM1-2KVA Service Manual: July 1989

3.7.2.2.7 Data Archive Tape Unit

The user station will have a data archive tape unit interfaced to the data archive computer system. The tape unit will store no less than 12.3 Gbytes of data on a single cassette tape. The cassette tape will be removable and will be an industry standard cassette. The tape unit shall store the products for an eight hour shift (8340).

The tape unit will perform as described in the vendor manuals:

SUMMUS User's Installation and Operation Manual: Rev 02, April 1988

SUMMUS Interface User's Manual (Man No. IMG-002), Rev 2, Feb 1989

SUMMUS Specifications Manual (Man No. SMG-001), Rev 1, Sept 1988

SUMMUS PC User's Manual (Man No. UMGDPC-001),

SUMMUS AT Host Adapter Reference Manual (Man No. UM442ATC-001), Rev 1, March 1989

3.7.2.2.8 Environmental Control Unit

The ECU will control the environment within the user area to allow the normal operation of the system and comfort of the user and operating personnel.

3.8 Precedence

In the event of conflict between the provisions of this specification for the MARX IV-B and other referenced documents, the following precedence shall apply:

a. The System Segment Specification
b. The Statement of Work
c. This Specification
d. Documents referenced herein.

4. QUALITY ASSURANCE PROVISIONS

4.1 General

4.1.1 Responsibility for Tests

Testing shall be conducted at the contractor facility in Austin, Texas; or at the facility specified in the System Test Plan (STP). Tests will be witnessed by contractor Product Assurance (PA) personnel and by the Government as appropriate and will meet the requirements of MIL-Q-9858A.

4.2 Quality Conformance Inspections

The MARK IV-B shall be tested to verify conformance to all requirements in Section 3 of this specification. The contractor shall use the verification methods described in the following subparagraphs. The MARK IV-B shall be subjected to the verification/demonstration tests as shown in the MARK IV-B Requirements Traceability Matrix (RTM) to ensure satisfaction of the requirements of this specification.

4.2.1 Verification

The verification methods defined in the following subparagraphs establish how each verification/conformance requirement shall be met: Inspection, Analysis, Demonstration, and Test.

4.2.1.1 Inspection

An observation or examination of the item against the applicable documentation to confirm compliance with requirements.

4.2.1.2 Analysis

A process used in lieu of or in addition to testing to verify compliance with specifications. The technique typically includes interpretation or interpolation / extrapolation of analytical or empirical data under defined conditions or reasoning to show theoretical compliance with stated requirements.

4.2.1.3 Demonstration

An exhibition of the operability or supportability of an item under intended service-use conditions. Demonstrations may be accomplished by computer simulation.

4.2.1.4 Test

An action by which the operability, supportability, performance capability, or other specified qualities of an item are verified when subjected to controlled conditions that are real or simulated. These verifications may require use of special test equipment and instrumentation to obtain quantitative data for analysis as well as qualitative data derived from displays and indicators inherent in the item(s) for monitor and control.

4.2.1.5 "Not Applicable"

Use of the term "Not Applicable" (N/A) shall be limited to those paragraphs/paragraph headings for which there is no method of verification or where verification is accomplished in subparagraphs.

4.2.2 Components

Before assembly, all active components, subassemblies, and assemblies shall have been inspected, tested, and accepted in accordance with their respective specifications and drawings.

4.2.3 Environmental Stress Screening

ESS is performed by quality assurance test technicians on each Newly Developed Component. As the MARK IV-B development program progresses, ESS performance data will be collected and plans for production ESS will be developed. Alternate vibration methods or thermal cycle profiles will be evaluated for optimum results.

5. PREPARATION FOR DELIVERY

5.1 Levels of Protection

The MARE IV-B equipment shall be prepared for initial delivery to the Government in accordance with the applicable levels of preservation, packaging, packing, and marking specified in MIL-P-9024G.

6. NOTES

6.1 Acronyms

The acronyms listed below include all those used in this specification. The list also includes most of those used in documents relating to this specification.

2-D	Two Dimensional
3-D	Three Dimensional
A_o	operational availability
A_i	inherent availability
ACU	Antenna Control Unit
ADCCP	Advanced Data Comm. Control Procedure
ADP	Automatic Data Processor
AFB	Air Force Base
AFCC	Air Force Communication Command
AFGWC	Air Force Global Weather Central
AFM	auxiliary function module
AFR	Air Force Regulation
AFSC	Air Force Space (System) Command
AG	Aerographers Mate
ALMEDS	Alaska Meteorological Distribution System
AMSU	Advanced Microwave Sounding Unit (NOAA Sensor System)
APDS	AWDS Product Driver Subsystem
ASAR	Automated Support Assistance Request
ASAS	All Sources Analysis System
ASCII	American Standard Code for Information

	Interchange
ASD-TDR	Atmospheric Sounding Data-Temperature Data Records
ATC	Air Training Command
AVHRR	Advanced Very High Resolution Radiometer (NOAA Sensor System)
AWDS	Automated Weather Distribution System
AWN	Automated Weather Network
AWS	Air Weather Service
BER	Bit Error Rate
BERT	Bit Error Rate Tester
BF	Blank Frame
BPI	Bits per inch
BIT	built-in test
BITE	built-in test equipment
BIU	Bus Interface Unit
BPS	Bits per second
BPSK	Biphase Shift Keying
BRDF	Bidirectional Reflectance Distribution Function
BWOFS	Battlefield Weather Observation and Forecast System
C^2P	command and control processor
C_3S	Command and Control and Communication Segment
C	Celsius
CCTV	closed circuit television
CDRL	Contract Data Requirements List
CFEP	Communications Front End Processor
CFM	cubic feet per minute
CH	Cell Height
CI	Configuration Item
CIDE	Combined Information Data Exchange
CM	Centimeters
CM/Hr	Centimeters per Hour
CMNR	Common Mode Noise Rejection
COMEDS	CONUS Meteorological Distribution System
COMSEC	Communications Security
CONCAP	Constituent Capability

CONUS	Continental United States
COTS	Commercial-Off-The-Shelf
CPCI	Computer Program Configuration Item
cps	characters per second
CPU	Central Processing Unit
CRT	Cathode-ray tube
CSR	Control and Status Register
CSC	Computer Software Component
CSCI	Computer Software Configuration Item
CW	Cell width, Cloud Water
dB/K	Decibels/degree Kelvin
dBm	Decibels, Power (10 Log P1/P2) referenced to one milliwatt
dBmi	Effective radiated power in decibels above one milliwatt referenced to an isotropic antenna with gain of 1
DBMS	Database Management System
dBW	Decibels, Power (10 Log P1/P2) referenced to one watt
DCA	Defense Contracts Agency
DCS	Deputy Chief of Staff
DD	Dewpoint Depression (in % sup o C)
DDN	Defense Data Network
Deg	Degree
DMA	Direct Memory Access; Defense Mapping Agency
DMSP	Defense Meteorological Satellite Program
DMDM	Direct Mode Data Message
DMSP	Defense Meteorological Satellite Program
DMSS	Defense Meteorological Satellite System
DNA	Defense Nuclear Agency
DoD	Department of Defense
DTSS	Digital Topographical Support System
DTT	Development Tactical Terminal
E^3	electromagnetic environmental effects
ECC	Error Correcting Code
EDAC	Error Detection and Correction
EDM	engineering development model
EFTO	Encrypted for Transmission Only

EIRP	Effective Isotropic Radiated Power
EMC	Electromagnetic Compatibility
EM1	Electromagnetic Interference
EMP	Electromagnetic pulse
ENVIROSAT	ENVIROnmental SATellite
E-O	Electra-Optical
EP	Environmental Parameters
ESDI	Enhanced Small Device Interface
ESS	environmental stress screening
ET	Electronic Technician
ETC	Elapsed Time Count
EURMEDS	European Meteorological Distribution System
EWCM	Electronic Warfare Control Module
F	Fahrenheit
FAX	Facsimile
FB	Formatted Binary
FED-ST	Federal Standard
FFD	Fraction of Failure Detected
FFI	Fraction of Failure Isolated
FFT	Fast Fourier Transform
FM	Frequency Modulation
FM-FM	Dual Frequency Modulation
FLAPS	Force Level Automated Planning System
FNOC	Fleet Numerical Oceanography Center
FQT	Formal Qualification Testing
Ft	Feet
FY	Fiscal Year
GAC	Global Area Coverage
GFE	Government Furnished Equipment
GFI	Government-furnished information
GFP	Government Furnished Property
GHz	Gigahertz (10^9Hz)
GMS	Geostationary Meteorological Satellite (Japan)
GOES	Geostationary Operational Environmental Satellite (U.S.)
GOES-NEXT	The GOES I through M satellites
GOMS	Acronym for planned Soviet geostationary satellite

GPS	Global Positioning System
G/T	Gain/System Temperature
GVAR	GOES I-M VARiable Data Transmission Format
HF	High Frequency
HFRB	High Frequency Regional Broadcast
HGSG	Harris Government Systems Group
HEMP	High-Altitude Electromagnetic Pulse
HOL	Higher-order language
HRPT	High Resolution Picture Transmission
HWD	Horizontal Weather Depiction
HZ	Hertz (cycles per second)
I/O	Input/Output
I/F	Interface
ICD	Interface Control Document
IDD	Interface Design Document
IF	Intermediate Frequency
ILS	Integrated Logistics Support
In	Inches
In/Hr	Inches per Hour
IOC	Initial Operational Capability
IR	Infrared
IRS	Interface Requirements Specification
IS	Interface Specification
ISS	Instructional Software System
ITDA	Integrated Tactical Decision Aid
JSIPS	Joint Services Imagery Processing System
JMA	Japan Meteorological Agency
K	Degrees Kelvin
Kg	Kilograms
Km	Kilometer
Kts	Knots
KVA	Kilo-Volts-Amperes
L-BAND	Frequency Range Between 0.39 and 1.55 GHz
LAC	Local area coverage
LAN	local area network
Lat	Latitude
LDT	Logistic Delay Time
LED	light emitting diode
LF	Light Fine

LMSC	Lockheed Missiles & Space Co., Inc.
LOL	Lower-Order Language
Lon	Longitude
LR	Low Resolution
LRU	Line-replaceable unit
LS	Light Smooth
LS-2D	2-Dimensionally Smoothed Light - Smooth
LSA	Logistic Support Analysis
LSB	Least Significant Bit
LSF	True Sync Frame
LSSF	Line Sub-Sync Frame
LUT	Look-up Table
M	Meters
Mmax	Maximum Corrective Maintenance Time
MBA	Multibus Adapter
MBPS	Mega Bits Per Second
MBar	Millibars
MDEMO	Maintainability Demonstration
METSAT	Meteorological Satellite
MHZ	Megahertz
Mi	Mile
MIL-STD	Military Standard
MIPS	million instructions per second
MM	Millimeters
MM/Hr	Millimeters per Hour
MMH/OH	Maintenance Manhours/Operating Manhour
MMI	Man-Machine Interface
MOLS	Multispectral Operational Linescan System
MOS	Modal Output Statistics
Mph	Miles per Hour
M/S	Meters per Second
MSB	Most Significant Bit
MSC	Meteorological Satellite Coordinator
MSD	Mission Sensor Data
MSP	Mission Sensor Processing
MSS	Multispectral Scanner; Mission Support System
MTBCF	Mean Time Between Critical Failures
MTBCMA	Mean Time Between Corrective Maintenance

	Action
MTBF	Mean Time Between Failure
MTBFA	Mean Time Between False Alarms
MTF	Modulation Transfer Function
MTTR	Mean Time to Repair
Mode A	Current GOES data format
Mode AAA	Expanded GOES data format
NBC	Nuclear, Biological and Chemical
NDI	nondevelopment items
NEPH	Nephanalysis (Cloud characteristics)
NESDIS	NOAA's National Environmental Satellite, Data and Information Service
NESS	National Environmental Satellite Service
NM	Nautical Mile
N Mi	Nautical Mile(s)
NOAA	National Oceanographic and Atmospheric Administration (US Department of Commerce)
NOSC	Naval Ocean Systems Center
NRL	Navy Research Laboratory
NRZ-L	Non-Return-To-Zero Level
NRZ-S	Non-Return-To-Zero Space
NTSC	National Television Standards Convention
OCR-AWDS	Optical Character Reader-Automated Weather Distribution System
OGE	Operations Ground Equipment
OJT	On-the-Job Training
OLS	Operational Linescan System
OPEVAL	Operational Evaluation
OT&E	Operational Test & Evaluation
PACMEDS	Pacific Meteorological Distribution System
PCM	Pulse Code Modulation
PCU	Pedestal Control Unit
PEMU	Power and Environmental Monitoring Unit
PIDS	Prime Item Development Specification
PLA	Programmable Logic Array
PM	preventive maintenance
PM	Phase Modulation
PMD	Preventive Maintenance Downtime
PMT	Photo Multiplier Tube

POES	Polar Orbiting Environmental Satellite
POM	Program Objective Memorandum
PPL	Provisioning Parts List
PQT	Preliminary Qualification Testing
PROFS	Program for Regional Observation and Forecasting Services (NOAA Environmental Laboratory Office in Boulder, Colorado)
PSD	Power Spectrum Density
PSK	Phase Shift Keying
PUI	Project Unique Identifier
PWB	printed wiring board
QPSK	Quadriphase Shift Keying
RAM	random access memory
RATT	Radio Telephone Teletype
RBA	Relative Byte Address
RBS	Regional Broadcast System
RDS	Real Time Data Smooth
RF	Radio Frequency
RGB	Red-Green-Blue
RHCP	Right-Hand Circular Polarization
ROM	Read Only Memory: Rough Order of Magnitude
RTD	Real Time Data
RTM	Requirements Traceability Matrix
RTNEPH	Real Time NEPH analysis
RWM	Relocatable Window Model
S-BAND	Frequency Range Between 1.55 and 5.2 GHz.
S/N	Signal-to-Noise
SA	Surface Airway (hourly)
SAC	Satellite CSCI
SATCOM	satellite communication
SCC	Serial Communications Controller
SCN	Specification Change Notice
Sec	Second
SD	Space Division (US Air Force)
SDC	Space Data Corporation
SDF	Stored data fine
SDS	Stored data smooth
SESC	Space Environment Services Center (NOAA)
SEU	Single Event Upset

TECHEVAL	Technical Evaluation
TERDAT	Tertiary Data
TESS	Tactical Environmental Support System
TF	Thermal Fine
T I D S	Tactical Imagery Dissemination System
TIP	TIROS Information Processor
TIROS	Television/InfraRed Orbital Satellite
TM	Thematic Mapper
TMSS	Tactical Meteorological Satellite System
TOPS	Thermodynamic Ocean Prediction System
TOR	Technical Operating Report
TOVS	TIROS Operational Vertical Sounder (NOAA Sensor System
TRI-TAC	TRI-Service TACtical Communication System
TS	Thermal Smooth
TS-2D	2-Dimensionally Smoothed Thermal - Smooth
TSEC	Transmission Security
T/SSP	Telemetry Special Sensor Frame
TWI	Tactical Weather Intelligence
UA	Upper Air
UGDB(F)	Uniform Gridded Data Base (Field)
UHF	Ultra-High Frequency
UPS	Uninterruptible Power Supply
USA	United States of America
USAF	United States Air Force
USMC	United States Marine Corps
VAS	VISSR Atmospheric Sounder (NOAA Sensor System)
VF	Video Frame/Voice Frequency
VIP	VAS Image Processor
VISSR	Visual-Infrared Spin Scan Radiometer (NOAA Sensor System)
VLSI	very large scale integration
WEFAX	Weather Facsimile
WMO	World Meteorological Organization
WOC	Wing Operations Center
WSCID	Warfare System Controlled Interface Drawing

SFD	Store and Forward Data
SFWDE	Standard Formats for Weather Data Exchange
SGDB	Satellite Global Data Base
SGLS	Satellite Ground Link System
SIDS	Satellite Imagery Dissemination System
SMI	Synchronous Memory Interconnect
SOC	System Operational Concept: Satellite Operations Center
SOW	Statement of Work
SQE	Software Quality Evaluation
SRS	Software Requirements Specification
SRU	shop replaceable unit
SSM/I	Special Sensor, Microwave/Imager (DMSP Sensor System)
SSM/T	Special Sensor, Microwave/Temperature Sounder (DMSP Sensor System)
SSM/T-2	Special Sensor, Microwave/Water Vapor Sounder (DMSP Sensor System)
SSP	Special Sensor
SSP/V	Special Sensor/Video Frame
sss	System Segment Specification
STD	Software Test Description
STE	Special Test Eguipment
STL	Surface Temperature Over Land
STS	Surface Temperature Over Snow
Si	Silicon
TACC	Tactical Air Control Center
TACS	Tactical Air Control System
TACTERM	Tactical Terminal
TAF	Terminal Aerodrome Forecast
T_B	Brightness Temperature
TBD	To be Determined
TBR	To be Revised
TBS	To be Specified/To Be Supplied
TCHTG	Technical Training Group
TCHTW	Technical Training Wing
TDA	Tactical Decision Aid
TDP	Tactical Data Processor
TDR	Temperature Data Record

10. APPENDIX I - Boftware Development and Maintenance

10.1 Development Tactical Terminal Equipment

The Development Tactical Terminal (DTT) equipment will consist of a standard MARK IV-B tactical system with additional equipment integrated to allow the development of new software and data bases etc., and to allow the monitoring of the performance of the Input and Product Computer bus characteristics. This additional equipment is described in the following paragraphs.

10.1.1 Processing Area

The Product computer in the Processing area shall have an added reel-to-reel g-track tape drive. This tape shall allow for the fast loading and unloading of large amounts of data, and the input of Air Force or Navy data tapes for database generation, and distribution.

The same interface as used in the MARK IV-B system between the Database Management Function and mass storage devices shall be used locally for data archival and retrieval (18100). As a goal, disk drives of the same type as used in the operational MARK IV-B shall be compatible with the development tactical terminal (18110).

A high-speed modem shall be provided to transmit and receive data with outside users (18120). Additional hard copy units shall be in the DTT capable of producing copies of weather products and alphanumeric data (18130) (18140).

The DTT will contain a VMEbus and Multibus analyzer. The bus analyzers can be installed in any of the VME or Multibuses, and are used to monitor and/or analyze the loading and performance of the respective bus.

The DTT will contain a Laser page printer in the processing area for the printing of alphanumeric text (18130).

10.1.1.1 Update Media

The g-track tape in the MARK IV-B DTT system shall read sensor and static data from computer compatible magnetic tapes per ICD-CWD-3005. Format of the sensor calibration data shall be per ICD-CWD-3001 (SSM/I), ICD-CWD-3002 (SSM/T), ICD-CWD-3003 (SSM/T-2), ICD-CWD-3007 for AMSU and ICD-CWD-3006 for static data bases.

10.1.2 User Area

The Data Archive computer in the User area shall have two items added to it in the DTT configuration. The items are a standard keyboard, and a video monitor. These will allow monitoring, modification, and building of software releases for the software in the data archive computer.

10.2 Software Development and Maintenance Support

The contractor shall supply support equipment, and software needed to maintain the software in the system, this equipment shall be identical to that which is used for software development (7450). This equipment shall accommodate growth of the MARK IV-B computer system without modification (7560). This support shall include a computer system that is functionally equivalent, from the software point of view, to the computer in the MARK IV-B (7570).

10.3 Microprogram Development and Maintenance Support

The contractor will supply a list of the equipment required to support the maintenance and development of the microprogramming contained within the system (7280). The items to be included on the list are:

A) A software editor (7240)

B) A compiler and/or assembler (7250)

C) A translator with size and execution optimization (7260)

D) A downloader (7270)

E) An emulator (7290)

F) An execution tracer (7300)

G) A memory device programmer (7310)

H) A microcode simulator (7320)